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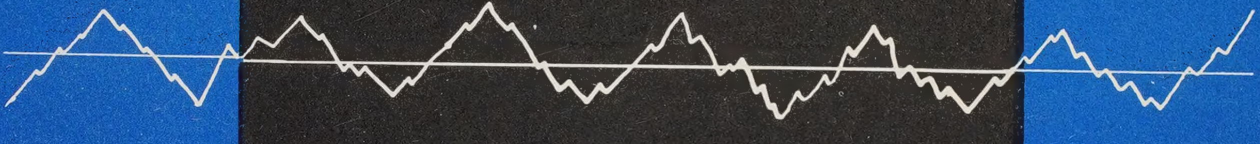

—A MONTHLY REPORT

March 1952

FOUNDATION FOR THE STUDY OF CYCLES
New York, New York

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cycles

—a monthly report

The Official Bulletin of the Foundation for the Study of Cycles

VOLUME III NUMBER 3 MARCH 1952

The Director's Letter

Dear Members:

In our February report I printed a letter from Dr. Warren Whitford of New Haven, Connecticut, which asked, supposing Mr. Dakin and I were rewriting **Cycles—The Science of Prediction**, would we, in the light of the Korean War and other factors, make any changes in what we said in that book.

I cannot speak for Mr. Dakin, who is unavailable, but I am very glad to give my personal answer to this question.

Summary of the Book

If you read the book you may remember that it dealt both with trends and with cycles.

In speaking of trend, the book emphasized that the rate of growth of everything that grows decreases as the organism gets older. Charts were presented to show that this law holds good for the growth of yeast cells in a bottle, for plants (for example, a pumpkin), for animals (for example, a white rat), and for the population of a nation. It was shown that the economic affairs of a country or of an individual company also conform to this universal law.

In regard to cycles, the book reported the existence of many cycles in natural and social affairs, but it emphasized four cycles of especial importance in the economic and social life of this country. More particularly it dwelt upon cycles of 3 1/2 years, 9 years, 18 1/3 years, and 54 years in length.

Changes I would Make Today

If I were writing a book today on the subject of trends and cycles what changes would I make?

First of all, I would try not to simplify the subject quite so much. In the eight years that have elapsed since **Cycles** was written a good deal has been learned about the importance of many other cycles in the natural and social sciences. These other cycles must also be taken into account if we are to get adequate light in regard to the probabilities of the future. In writing a new book I would dwell upon this fact and give many illustrations of the sort that I print currently in our monthly report.

Also, if I were writing a book on this subject at the present time I would emphasize to a greater extent the ever-present possibility that any given cycle may be the result of random forces and may therefore not continue. I would also want to explain how cyclic forces of approximately the same length can combine in such a way as to produce a compound cycle which will eventually fade out and then reappear upside down—a fact I did not know in 1944.

In short, I find the subject of cycles to be much more complicated than it seemed to be eight years ago. If I were writing a book today I would give greater emphasis to this complexity.

Let me now be more specific in regard to changes and additions I would make.

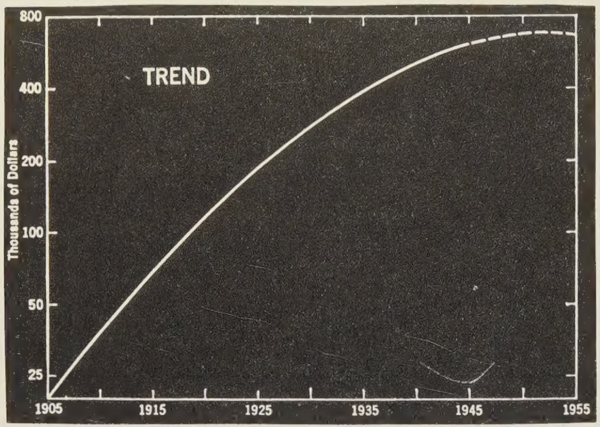


Fig. 1 Typical Growth Trend

The 54-Year Cycle

In the book the 54-year cycle was represented as being, except for war distortions, the most important single characteristic of wholesale prices, in gold, in this country. In a new book that statement would continue to stand, and so would the date of 1952 as the time of trough of the ideal 54-year cycle in wholesale prices.

The term "ideal cycle" may need a word of explanation. To make the concept simple consider the annual temperature cycle: The ideal time for the coldest day of the year is, let us say, February 1. However, in any given year February 1 may be a nice warm day. The coldest day of the season may come a month or two either way from this date.

The same thing is true of cycles of other lengths. The actual low of a cycle may come a substantial fraction of the cycle either before or after ideal timing. In other words, even without World War II, and World War III, which has already begun, the 54-year low of actual average wholesale prices, in terms of gold, could fall a dozen years or more either way from 1952. The year 1952 is merely the ideal.

For a chart showing average wholesale prices from 1830, and such prices in both gold and paper from 1933 to date, refer to pages 236 and 237 of our report for June 1951.

The 54-Year Cycle Present in Many Phenomena

In the book **Cycles** the 54-year cycle was shown to be present not only in average wholesale prices in the United States, Great Britain, and Germany, but in wheat prices in England (from 1260 A. D.), in the wages of agricultural laborers and textile workers in England, in the value of French rente and English consols, in coal, pig iron, and lead production in England, and in coal consumption in France, but no attempt was made to date the ideal 54-year cycle in these other phenomena.

(Incidentally, it may be stated that as yet there is no evidence of a 54-year cycle in the prices of industrial common stocks.)

No changes need to be made in regard to what was said to **Cycles** about any of these matters but two important additional discoveries would be referred to in a new book.

First, a cycle of 54 years in the thickness and thinness of Arizona tree rings has been found to be present on the average in each third of the data from 1100 A. D. forward. (See Foundation Report No. 4.) This fact suggests that the 54-year cycle may be even more fundamental than was originally supposed.

Second, work which has been done on one of the longest series of production figures in this country suggests that the 54-year cycle in production has a very different timing from the 54-year cycle in prices. Whereas the last crest in the ideal 54-year cycle in **prices** came in 1925 there is reason to believe that the last crest of the 54-year cycle in **production**

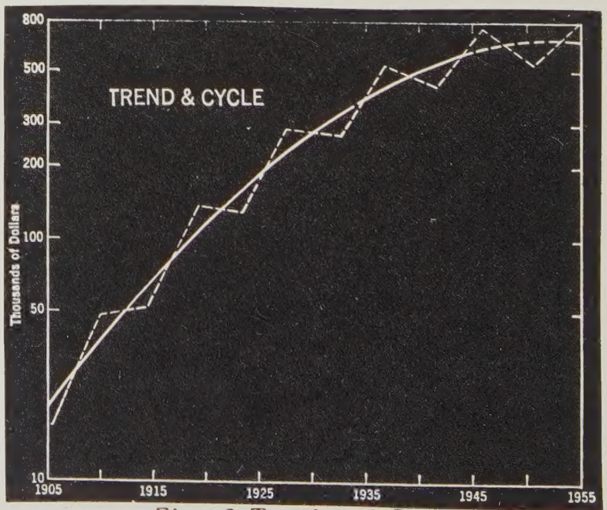


Fig. 2 Trend and Cycle

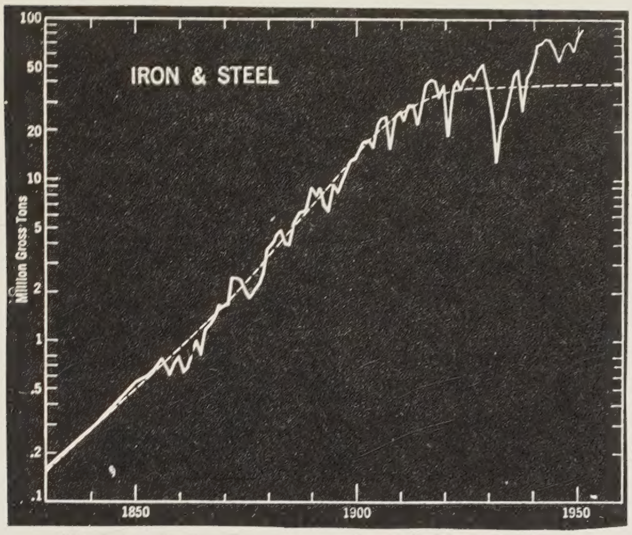


Fig. 3 U.S. Iron and Steel Production

PIG IRON PRODUCTION 1830-1913. STEEL INGOT PRODUCTION 1914-1951. A TREND IS SHOWN BASED ON BEHAVIOR UP TO WORLD WAR II

came in the first decade of the century, 15 or 20 years earlier. The last trough of the ideal 54-year cycle in **production** seems to have come in the 1930's, the exact year depending upon the industry concerned.

Strength in Production Until the 1960's

If we can generalize from the limited amount of work done to date, we would expect those aspects of industrial production showing the 54-year cycle to evidence strength until the 1960's. After that time we might look forward to a slackening in the rate of growth similar to the slackening which occurred in many such series of figures from about 1910 to the middle of the 1930's, only more pronounced.

We would expect the slackening to be more pronounced than the earlier retardation because the country will be older then, and the basic underlying rate of growth can be expected to be somewhat less than it was a half century earlier.

Summarizing the 54-Year Cycle

Now let me sum up in regard to the 54-year cycle:

If this cycle is real, as it seems to be, and if it continues, the normal tendency for average wholesale **prices** in terms of gold should be generally upward for the next 25 years or so. War would naturally increase this tendency, and inflation would make currency (paper) prices even higher.

For those aspects of **production** controlled by the 54-year cycle the golden era would seem to be already here, with 10 years or more to run. Bear in mind, however, that the 54-year cycle does not control production except in a general way and that one must expect intermediate ups and downs of considerable importance. Bear in mind also that much of the cur-

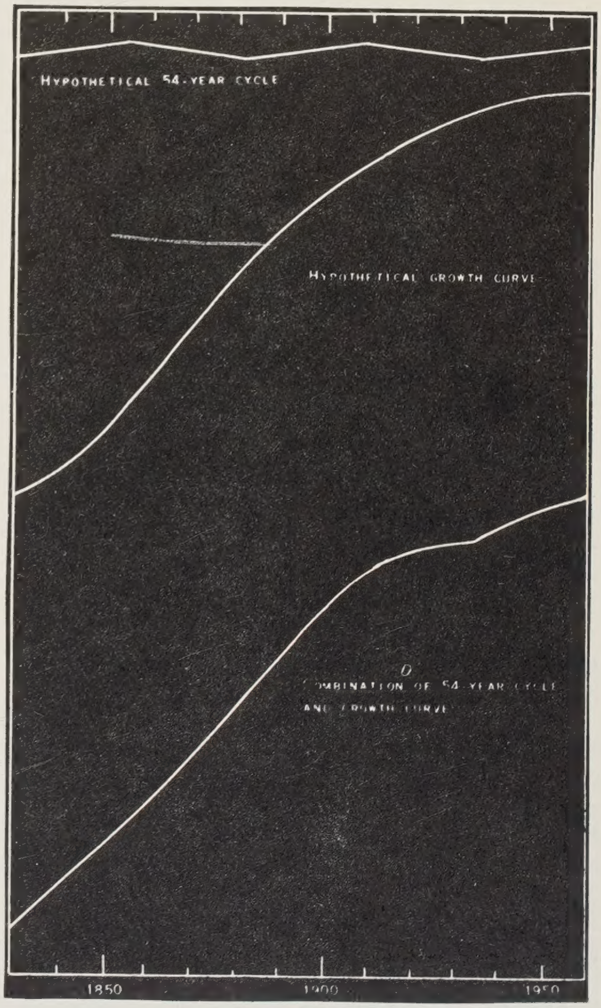


Fig. 4 A 54-Year Cycle, A Growth Curve, and Their Synthesis

THE SYNTHESIS APPROXIMATES THE BEHAVIOR OF IRON AND STEEL PRODUCTION FROM 1830 TO DATE, AND SUGGESTS THAT A 54-YEAR TENDENCY MAY BE PRESENT IN THESE FIGURES.

rent production activity is frenzied preparation for a shooting World War III, and that any drastic cessation of such preparation would overwhelm the normal upward effect of the 54-year cycle.

In other words, we are in a situation in respect to production where the hurricanes of war are largely in control and the underlying tides of the cycles temporarily occupy a subordinate position. Even so, it is reassuring to know that the most important cyclic tendency in production discovered to date is upward at the present time.

All of this augurs well for the general course of industrial production in this country for the next 10 or 15 years, barring war distortions, but sounds a note of caution for the 25-year interval to follow.

Trends

In the book, **Cycles**, you saw that growth normally occurs at a decreasing rate. Growth data, when plotted on ratio ruling, ideally show a curve concave downward as in Fig. 1. (The cycles wrap themselves around the underlying growth trend as in Fig. 2.) A number of growth curves were shown which conformed more or less to this idealized pattern.

However, some industries were seen to have growth curves of peculiar shape. For example, the iron and steel industry grew at an almost uniform rate until the early 1900's after which the rate of growth flattened sharply and continued almost horizontally until World War II. See Fig. 3.

Data for iron and steel production in this country do not go back far enough to enable us to know whether or not a 54-year cycle is present in this activity. If, however, we assume that it is present with a crest about 1908 we have an explanation for the peculiar behavior observed. We also have an explanation for the great post war strength of this industry even before the outbreak of World War III. Refer to Fig. 4 which shows the combined effect of a growth trend of more normal shape and a hypothetical 54-year cycle cresting in the first decade of this century. Such a combination would produce the behavior we observe in pig iron production.

My own belief is that this may be the true explanation of the peculiar shape of the iron and steel production curve and that, disregarding war distortions, we can expect underlying strength in this industry until the 1960's. After the 1960's however, we might expect a leveling off similar to the leveling off experienced from about 1908 to about 1935.

Similar behavior can be expected in other production series where the 54-year cycle has turning points at the same time.

Knowing what I now know about the 54-year cycle in production I would advance this idea in a book written at the present time. Also, in line with the idea I would change the trend lines for a number of industries, sloping them upward from about 1935 forward to take account of the 54-year tendency as well as true underlying growth.

* * *

When I started to dictate this letter to you I intended to discuss in detail the 18 1/3-year cycles, the 9-year cycles, and the 3 1/2-year cycles that were treated so prominently in the book. I also had in mind to summarize what we now know about other cycles present in our economy. However, I am afraid that in discussing the 54-year cycle and the subject of trends I have been too long-winded, for I have used up all of the available space. I shall therefore have to make a continued story out of my answer to Dr. Whitford. I shall have to defer until our next report the discussion of the other cycles, and the implication they carry for the future.

Very cordially yours,

Edward R. Dewey
Director

PLANETARY EFFECTS ON SHORTWAVE RADIO

by
John H. Nelson, Propagation Analyst
RCA Communications, Inc., New York

Editor's Note: You will doubtless remember Mr. John Nelson as the person to whom the Foundation for the Study of Cycles recently awarded a gold medal for "notable service in the field of radio propagation and planetary cycles". An account of the presentation was contained in our December 1951 report.

Mr. Nelson s work is interesting to me for three reasons. First of all, it illustrates another successful application of forecasting based upon a knowledge of cycles. Using such knowledge, Mr. Nelson's forecasts of radio "weather" have attained an accuracy of about 80%.

Second, the correspondence in timing and time span between the cycles of shortwave radio disturbances over the North Atlantic and planetary cycles interests me because it shows how a knowledge of cycles can suggest the possibility of a cause which might otherwise be unsuspected. That is one reason why we study cycles—to help trace causes.

Third, I find myself interested in Mr. Nelson's work because I want to know if there are correspondences between these planetary cycles of his and terrestrial phenomena other than radio disturbances. Are there corresponding cycles in weather for example, or corresponding cycles in plants and/or animals—or man? All of these possibilities need to be explored in the months to come.

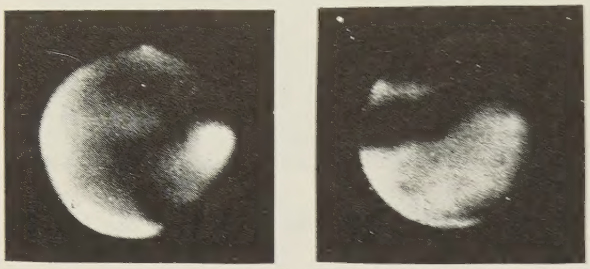
With these thoughts in mind Mr. Nelson has promised to give me the exact dates of his various cycles. I plan to publish these dates so that you can compare his cycles with the terrestrial cycles in which you may be interested to see if there are correspondences. Who knows what may turn up?

This article has been prepared as a general report on my research at the request of Mr. Dewey. Pressure of other work, at present, prevents preparing a formal paper. I hope to be able to offer something more formal sometime in 1952.

I have been intimately associated with shortwave radio at RCA Communications, Inc. since the beginning of shortwave transatlantic communications in 1925. From about 1930 to 1946, I held a supervisory post at the Central Radio Office in New York being thus engaged in the assignment of circuits and frequencies. I was greatly interested in shortwave signal behavior throughout this whole period and gathered a wealth of practical experience. Also during this period I was actively engaged in amateur astronomy. The chief engineer, knowing this, transferred me from supervisory work to research in 1946. A six inch refracting telescope was purchased and installed at the Central Radio Office. I was assigned to the study of sunspots in an effort to develop a method of forecasting radio storms.

Forecasting on the Basis of Sunspots Inadequate

After about one year of research on sunspots, a fairly reliable forecasting service was inaugurated based on the position, age, activity, and classification of sunspots. Failures of this system, from time to time, indicated that some phenomena other than sunspots needed to be considered.



MARS PHOTOGRAPHED IN THE LIGHT OF DIFFERENT COLORS. LEFT, ULTRA VIOLET; RIGHT, YELLOW. FROM **Astronomy** BY SKILLING AND RICHARDSON.

In 1948 the work that Ellsworth Huntington, Henry Helm Clayton, and Fernando Sanford had done in correlating sunspot numbers with planetary positions came to my attention. I was sufficiently impressed with the results of their work to engage in correlating planetary relationships with variations in shortwave radio signal behavior. The same Heliocentric angles that they were interested in, the 0°, 90°, 180°, and 270° angles were used.

Planetary Positions Provide the Answer

All these angles between Mercury, Venus, Earth, Mars, Jupiter, and Saturn have been correlated with every eight hour period of the technicians logs from the RCA Communications, Inc. receiving station located at Riverhead, Long Island, for a period of seven years. In addition to these seven years, I have also checked planetary positions with all the severe storms as far back as 1940 and a number in the 1930 to 1933 period. The correlation indicates a very definite planetary position effect on Shortwave Radio Signals that travel on a Great Circle route that takes them near the Auroral Zone.

All Planets Out to Pluto Important

After the publication of my paper, "Shortwave Radio Propagation Correlation with Planetary Positions", last March in the RCA Review, the Propagation Analyst, Mr. J. H. Clark, of Press Wireless Inc. New York, engaged in planetary and shortwave radio signal research using the methods given in my paper but including all planets out as far as Pluto. He notified me in August 1951 that he had confirmed my findings and gave me the additional information that the three most distant planets also had an effect. He found Pluto especially effective. I have checked these planets myself since then and am in complete agreement with him.

"Multi-Cycles"

These critical angles between planets may actually be looked upon as the peaks of cycles. When several cycles peak at the same time, we should expect maximum effects. This is exactly what happens in cases where three planets become spaced at multiples of 90° a day or two apart. I have named these "multi-cycles" and consider one to exist when any of the following arrangement take place.

1. Two planets spaced at 0° with a third planet at 90°, 180°, or 270° from them.

2. Two planets spaced at 180° with a third planet 90° from each.

In such cases the cycle between planets A and B coincides with the cycles between C and A and C and B. These multi-cycles appear quite frequently and have shown very reliable correlation with radio storms.

SATURN, SHOWING CHANGES IN APPEARANCE OF RINGS. ONCE IN ABOUT 15 YEARS THE EDGE IS TURNED TOWARD US, AS IN THE 1921 PHOTOGRAPH. THEN THE RINGS ARE INVISIBLE BECAUSE THEY ARE SO THIN.

THE QUALITY OF RADIO SIGNALS IS ASSOCIATED WITH THE CYCLE CURVES OF SATURN AND JUPITER. (LOWELL OBSERVATORY.) FROM **Astronomy** BY SKILLING AND RICHARDSON. © HENRY HOLT & COMPANY.

"Uni-Cycles"

Uni-cycles show the least effects but often when several uni-cycles between isolated pairs of planets coincide in time the effects are very pronounced. In such cases a cycle between A and B would coincide with a cycle between C and D, etc.

Occasionally two, and even three, separate complete multi-cycles occur within a space of a few days bringing on severe prolonged storms. At other times, a multi-cycle will be mixed up with one or more uni-cycles.

Slow Planets

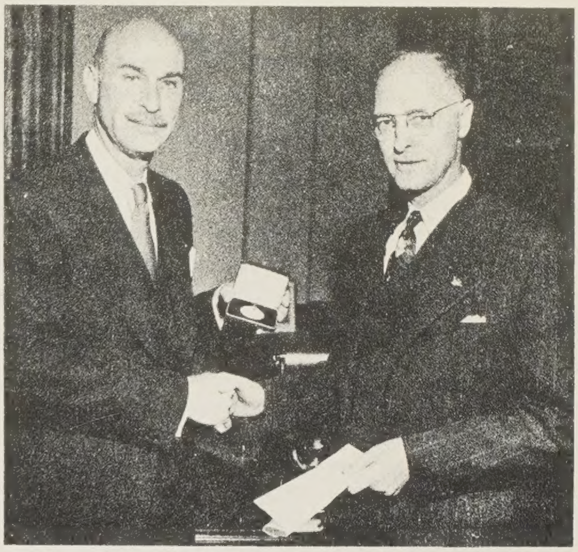
I have also noticed when any two slow planets are spaced by 60° or 120° that they apparently have a stabilizing effect. During these periods a very strong grouping of cycles is required to produce a storm. Many of the weaker cycles turn out to be ineffective. The reverse is noticed when any two slow planets are spaced by a multiple of 90°. During these period even normally weak cycles show an effect. These effects are most pronounced when Jupiter and Saturn are the slow planets involved.

When we include all cycles between all planets we find a large number of cycles but fortunately (for the correlator) the cycles have a tendency to come in groups instead of being evenly spaced in time. These groupings are quite random.

Forecasts Correct

The cycles among the slow planets have long term effects establishing an overall standard but do not in themselves create storms. The storms come as the faster planets make cycles with them or against themselves. Jupiter and Saturn at nearly 180° as they are now, with Uranus nearly 90° from each established the standard for 1951 which has been one of the most stormy years in the 25 year history of shortwave radio. That 1951 would be a difficult year for radio was predicted in 1949 based on a deduction that grew out of my research. This forecast was correct **even though sunspot activity has declined.** The forecast proved of considerable value to RCA Communications, Inc. for long range planning.

It is worthy of note that in 1948 when Jupiter was 120° ahead of Saturn, and solar activity was at a maximum, radio signals averaged of far **higher quality** than they have in 1951 with Jupiter and Saturn at 180° and a considerable decline in solar activity. In other words, the quality curve of radio signals has followed the cycle curve between Jupiter and Saturn rather than the sunspot curve.



Mr. John H. Nelson of R.C.A. Communications, Inc. (right) receiving gold medal from Mr. George Baekeland, Chairman of the Board of Directors of the Foundation. The medal was bestowed for "notable service in the field of radio propagation and planetary cycles."

Correlation with Weather Cycles?

It would be interesting to learn if planetary multi-cycles show any correlation with weather cycles. The slow planets for the long term and fast planets for short term periods. The Synodic periods of such multiples can of course be determined from the Ephemeris. They need not be exact as a multi-cycle is still effective for plus and minus about 5° from exact arrangement.

In closing, I would like to place on record that I received valuable assistance from my brother, Carl W. Nelson of Gloucester, Massachusetts, during this research. He has been correlating planet positions with weather variations, being interested in amateur meteorology.

December 10, 1951

WHAT MADE THE BENNER FORECAST TICK?

The remarkable forecast of pig iron prices made by Samuel Benner in 1875 achieved its success in part because of a cycle about 9 years in length in these prices which continued after 1875, and in part because of other cycles which must have lengths about 1/2, 1/4, 1/5, 1/6 or some other unit fraction of 27 years, which also continued. The task ahead is to find these other cycles; then to make a new forecast, starting now.

IN the February report I told you of a remarkable forecast of pig iron prices made by Samuel Benner in 1875. This forecast promulgated a "cast iron rule" that, starting in 1834, low prices would come at intervals of 9, 7, and 11 years (a total of 27 years), and repeat; and that, starting in 1837, high prices would come at intervals of 8, 9, and 10 years (also a total of 27 years), and repeat.

He called this sequence a 27-year cycle, but he did not mean, as we would today, that prices tended to go up for 13½ years and then down for a like interval. He meant instead that each 27-year interval showed three nine-year cycles, with repetitive irregularities as indicated.

Benner Formula Shows Gain-Loss Ratio of 31 to 1, 1875 to World War II

The profit or loss that would have resulted from imaginary purchase and sale, and short sale, of pig iron according to the Benner formula from the time Benner's book was copyrighted up to World War II is as follows:

Twelve of your imaginary transactions would have been profitable, two would have shown losses.

The loss for the two unprofitable transactions was 9.3%, or an average of 4.6% per transaction. The gain for the 11 profitable transactions, not including the rise from 1915 to 1918 incident to World War I, was 288.5%—an average of 26.2% per transaction. If you include the rise from 1915 to 1918, the gain was 425.8%, or an average of 35.5% per transaction. If you start your imaginary trading in 1872, the date of high called for in Benner's formula, instead of in 1875, the year of copyright, your 12 profitable transactions would have shown 461.2% for the period, or an average of 38.4% per transaction.

Looked at another way, the gain-loss ratio from 1875 through 1935, not including the rise due to World War I, was 31 to 1; including World War I, 44.8 to 1; and starting at 1872, in accordance with the formula, 49.6 to 1.

What Made It Tick?

As a matter of common sense, a forecast of prices which comes true over a period of sixty years with a gain-loss ratio of 31 to 1 has something behind it beside luck. Let us therefore analyze the forecast to see what made it tick.

Two Possibilities

Basically Benner said two things: (1) There is, in pig iron prices, a cycle which averages about nine years long. (2) There are significant variations from a perfectly regular nine-year cycle which repeat at intervals of 27 years.

Was Benner's success due solely to the reality of the 9-year cycle or was it due partly to the repetitive variations, too?

It is easy to answer that one. All you have to do is to determine the average timing of the nine-year cycle during the period for which Benner had figures and make your own forecast as of 1875 on a strict rigid 9-year basis. If a forecast based on a simple nine-year cycle would have come out as well or better than Benner's forecast, the repetitive variations from perfectly regular nine-year timing which he noticed had nothing to do with his success. If on the other hand, using these variations from regular nine-year timing, his forecast was better than you would get by a straightforward projection of a nine-year wave, you must conclude that the variations may have had significance too.

Gain-Loss Ratio on Average 9-Year Cycle 6.2 to 1

A nine-year periodic table of Benner's pig iron prices, from 1843 to 1874 inclusive, shows lows of an average nine-year cycle to fall in 1843 and every nine years thereafter; highs to fall in 1846 and every nine years thereafter. Such a table is printed herewith as Table 1.

TABLE 1.

A nine-year periodic table of Benner's pig iron prices, in dollars per ton, 1843-1874 inclusive, together with mean and median values.

Base Year	Years after base year 1	2	3	4	5	6	7	8	9
1842	22.50	25.75	29 25	27 87	30.25	26.50	22.75	20.87	21.37
1851	22.62	36.12	36 87	27.75	27.12	26.37	22.25	23.37	22.75
1860	20.25	23.87	35 25	59.25	46.12	47.87	44.12	39.25	40.62
1869	33.25	35.12	48.87	42.75	30.25				
Sum	98.62	120.86	150.24	157.62	133.74	99.74	89.12	83.49	84.74
Average* (Mean)	24.66 Low	30.22	37.56	39.41 High	33.44	33.25	29.71	27.83	28.25
Typical* (Median)	22.56 Low	30 43	35.56 High	35.31	30.25	26.50	22.75	23.37	22.75 Low

*For the difference between "Average" and "Typical", see text

Imaginary purchase and sale, and short sale, on this basis, 1875 to 1951 inclusive, would have yielded profit and loss as shown in Table 2.

From the above table it is easy to see that during the interval 1875-1936 there would have been 10 profitable transactions showing a gain of 382.3%, or an average gain of 38.2% apiece and four unprofitable transactions showing a loss of 39.8%, or an average loss of 9.9% apiece, or a total gain loss ratio of 9.6 to 1, as compared to 44.8 to 1 for Benner's formula. If we leave out of consideration the gain due to the war peak of 1918 , as we did in evaluating Benner's forecast, we get a gain loss ratio of 6.2 to 1, as compared with 31.0 to 1 for Benner.

It could be argued that we did not pick our years of high and low correctly. Perhaps by taking merely an average wave as we did, the results were distorted by the civil war or other abnormalities. I would agree with this criticism.

Gain-Loss Ratio on Typical 9-Year Cycle 5.9 to 1

When you have so few cycles it is usually desirable to exclude from each column of a periodic table one or more pairs of excessively high and excessively low values so as to get typical behavior

TABLE 2

Profit and loss from imaginary purchase and sale, and short sale, 1873 or 1875 to 1951, according to a strict nine-year cycle, when the nine-year cycle is determined on average (mean) behavior, 1843-1874

Date	Buy at	Sell at	Short at	Cover at	Gain or Loss: Actual: Long	Actual: Short	Per Cent: Long	Per Cent: Short	Comment
1873			$42.79						Formula date
1875			25.53						Copyright date
1879				$21.72		$21.07		49.2	Formula profit
1879	$21.72			21.72		3.81		14.9	Copyright date profit
1882		$25.77	25.77		$ 4.05		18.6		
1888	18.88			18.88		6.89		26.7	
1891		17.52	17.52		-1.36		-7.2		
1897	12.10			12.10		5.42		30.9	
1900		19.98	19.98		7.88		65.1		
1906	20.98			20.98		-1.00		-5 0	
1909		17.49	17.49		-3.49		-16.6		
1915	14.01			14.01		3.48		19.9	
1918		33 25	33 25		19 24		137 3		World War I
1924	22.10			22 10		11 15		33.5	
1927		19.68	19 68		-2.42		-11.0		
1933	16.47			16.47		3.21		16.3	
1936		19.60	19.60		3.13		19.0		
1942	24.00			24.00		-4.40		-22.4	World War II
1945		25.02	25.02		1.02		4.3		Price Control
1951	*52.38			*52.38		-27 36		-109 4	World War III and "Fair" Deal

*Adjusted for comparability.

as distinct from average behavior. (In technical language, it is usually preferable to use the median or the average median instead of the mean.)

If, then, we compute the typical or median wave, instead of the average (mean) wave, lows fall half way between 1842 and 43 and every nine years thereafter, the highs halfway between 1845 and 1846 and every nine years thereafter.

Imaginary purchase and sale, and short sales, on this basis would have come out as shown in Table 3.

Projecting imaginary trading from 1875 through 1936 on the basis of the typical 9-year cycle as it showed itself from 1843 to 1874 yields three losses and nine profitable transactions—eight if we disregard the war gain of 1918.

The unprofitable transactions give you total losses of 37.3%; the profitable transactions (excluding the war gain of 1818) gives you a total of 256.5%. This makes for a gain-loss ratio of 6.9 to 1 as compared with 6.2 to 1 when you compute the dates of high and low on an average basis, and 31 to 1 if you use the Benner formula.

Gain-Loss Ratio on Best of all Possible 9-Year Cycles, 18.7 to 1

Let us go even further. Let us look at the years 1875 to 1935 with the benefit of that hindsight we all have so much of, and pick out the very best of all possible perfectly regular 9-year cycles between these years.

Years of low would be 1879 and every nine years thereafter, years of high would be 1881 and every nine years thereafter.

Imaginary purchase and sale, and short sale, of pig iron at annual average values for the best of all possible nine-year cycles, as indicated, would be as shown in Table 4.

The fourteen transactions, 1875 through 1935 would have shown two losses, twelve gains.

The gains, not including the long profit due to World War I, would have been 270.7%, the losses 14.5%, the gain-loss ratio 18.7 to 1.

Clear that Other Cycles Important

It is clear from the above demonstration that, although trading on a perfectly regular nine-year cycle from 1875 up to World War II would have been profitable, no matter which of these methods you use to determine the nine-year cycle, in no case would it have been as profitable as trading on Benner's formula. In other words, the irregularities noticed by Benner do have significance, and account in large measure for his success.

TABLE 3.

PROFIT AND LOSS FROM IMAGINARY PURCHASE AND SALE, 1872 OR 1875 TO 1951, ACCORDING TO A STRICT NINE-YEAR CYCLE, WHEN THE NINE-YEAR CYCLE IS DETERMINED ON **TYPICAL** (MEDIAN) BEHAVIOR, 1843 - 1874

DATE	BUY @	SELL @	SHORT @	COVER @	GAIN OR LOSS				COMMENT
					ACTUAL		PER CENT		
					LONG	SHORT	LONG	SHORT	
1872-1873			$45.87						FORMULA DATE
1875			25 53						COPYRIGHT DATE
1878-1879				$19 70		$26.17		57.1	FORMULA PROFIT
1878-1879	$19 70			19 70		5 83		22.8	COPYRIGHT DATE PROFIT
1881-1882		$25.47	25.47		$ 5.77		29.3		
1887-1888	19.91			19 91		5.56		21.8	
1890-1891		17 97	17.97		-1.94		-9.7		
1896-1897	12 52			12 52		5.45		30 3	
1899-1900		19.67	19.67		7 15		57 1		
1905-1906	19 43			19 43		.24		1 2	
1908-1909		17 53	17.53		-1 90		-9 8		
1914-1915	13.80			13 80		3.73		21 3	
1917-1918		37 28	37 28		23 48		170.1		WORLD WAR I
1923-1924	25 13			25 13		12 15		32 6	
1926-1927		20 66	20 66		-4 47		-17 8		
1932-1933	16 17			16 17		4 49		21.7	
1935-1936		19 14	19 14		2 97		18 4		
1941-1942	24 00			24 00		-4 86		-25.4	WORLD WAR II
1944-1945		24.51	24 51		51		2.1		PRICE CONTROL
1950-1951	49.77			49.77		-25 26		-103 1	WORLD WAR III AND 'FAIR" DEAL

TABLE 4

PROFIT AND LOSS FROM IMAGINARY PURCHASE AND SALE, AND SHORT SALE, 1872 OR 1875 TO 1951, ACCORDING TO A STRICT NINE-YEAR CYCLE THE TIMING OF WHICH WAS BASED ON AVERAGE (MEAN) BEHAVIOR, 1875-1937

DATE	BUY @	SELL @	SHORT @	COVER @	GAIN OR LOSS				COMMENT
					ACTUAL		PER CENT		
					LONG	SHORT	LONG	SHORT	
1872			$48 94						FORMULA DATE
1875			25.53						COPYRIGHT DATE
1877				$18.92		$30.02		61.3	FORMULA PROFIT
1877	$18.92			18 92		6.61		25.9	COPYRIGHT PROFIT
1881		$25.17	25 17		$ 6.25		33 0		
1886	18 71			18 71		6.46		25 7	
1890		18 41	18 41		- 30		-1.6		
1895	13 10			13.10		5.31		28 8	
1899		19.36	19.36		6 26		47 8		
1904	15.57			15 57		3.79		19 6	
1908		17.57	17 57		2 00		12.8		
1913	15 85			15 85		1 72		9 8	
1917		41 31	41 31		25 46		160.6		WORLD WAR I
1922	24 85			24 85		16.46	•	39 8	
1926		21 64	21 64		-3 21		-12 9		
1931	17 35			17 35		4 29		19 8	
1935		18 68	18.68		1 33		7 7		
1940	23 00			23 00		4.32		-23.1	WORLD WAR II
1944		24 00	24.00		1 00		4 3		PRICE CONTROL
1949	45 89			45 89		21 89		-91.2	WORLD WAR III AND "FAIR" DEAL

Other Cycles Harmonics of 27-Years

What are these irregularities? Obviously, if they repeat at 27-year intervals they must be the result of forces which are, or which at least can be described in terms of, harmonics (unit fractions) of 27 years, or near such harmonics. A list of the harmonics of 27 years is shown in Table 5.

Table 5
HARMONICS OF 27 YEARS.

Harmonic	Length	
Fundamental	27	years
1/2	13 1/2	years
1/3	9	years
1/4	6 3/4	years
1/5	5 2/5	years
1/6	4 1/2	years
1/7	3 6/7	years
1/8	3 3/8	years
1/9	3	years
1/10	2.7	
etc.		

We may conjecture therefore that the success of Benner's forecast was due not only to the continuing presence of a cycle about 9-years in length but to the continuing presence of cycles close in length to one or more of the other harmonics of 27 years.

Unless, however, all these cycles are exactly equal in length to these harmonics, after a while a rigid pattern repeating at 27-year intervals would get out of step with reality. This presumably has happened by now. All the cycles in this series of figures need to be redetermined if you are to have a forecast which will carry for the next 60 years.

The Task Ahead

The task ahead is to use the additional data and the improved statistical tools now available to us to make what I hope will prove to be an even more accurate forecast of pig iron prices. But I shall be quite pleased if some future student of cycles, looking back at our work 60 years or so from now, finds that purchases and sales, and short sales, based on our forecast, or one which you might make, shows, like Benner, after allowance for war distortions, gains which are 31 times as great as the losses.

THE 12.6-MONTH CYCLE IN THE SALES OF COMPANY G

YOU will remember that in the April 1951 report I listed a number of cycles revealed by a preliminary examination of the sales of Company G. One of these cycles was described as a 12.57-month cycle. (Actually it seemed to be 12.576 and so we really should have called the length 12.58.) The chart showed that it had pretty fair amplitude and that crests came in February of 1946 and every 12.58 months thereafter.

Since last April we have done quite a lot of work on this cycle. You will be interested in this work because this cycle seems to "stand up."

Originally we found this wave in the deviations from a 13-month moving average after correction for the typical seasonal pattern. These deviations are shown in Fig. 1 herewith. Fig. 1 also shows a perfectly regular 12.58-month wave which idealizes typical behavior.

There are so many other cycles present in this series of figures and so many accidental variations that the 12.58-month cycle did not show too clearly, but it was clear enough so that it was tentatively accepted and tentatively included in the synthesis and in the projection.

To get a more accurate picture of this cycle and to see whether or not there is any evidence of compound cycle behavior we recently subjected the figures to a weighted moving average manipulation with the result shown in Fig. 2. For details, refer to the technical section of this report on pages 99 - 109.

New members may not fully understand

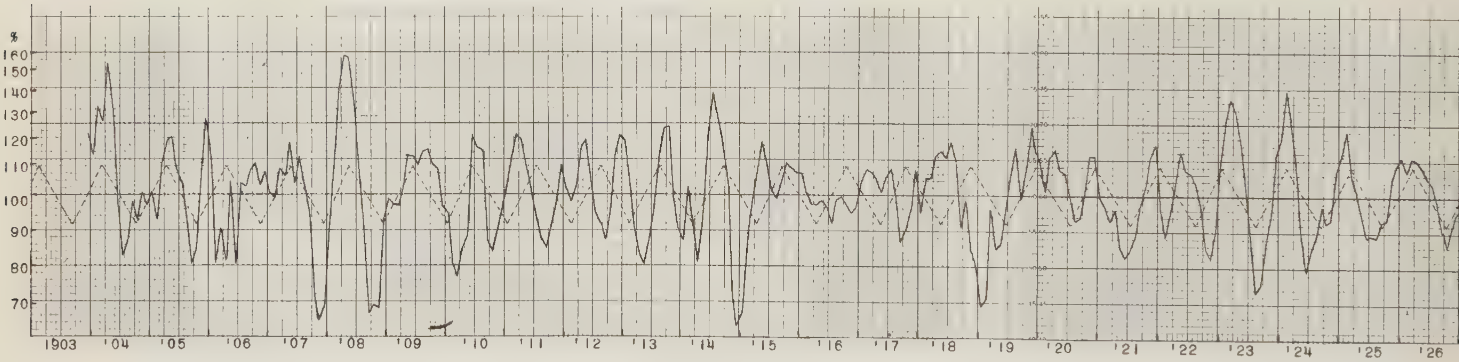


Fig. 1 Company G. Index numbers of deseasonalized net sales, expressed as percentages of their 13-month geometric moving average and smoothed by a 3-month geometric moving

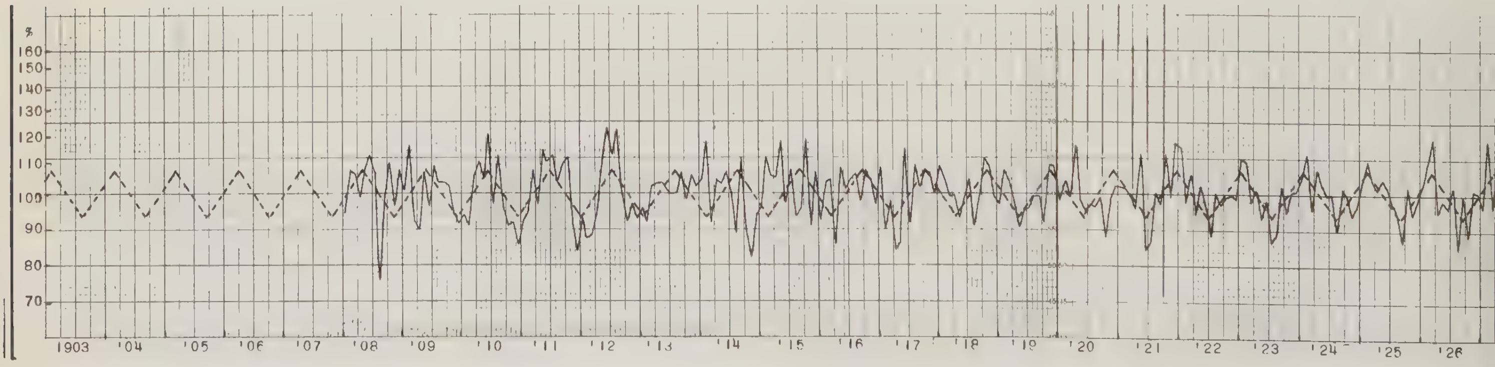


Fig. 2 Company G. A 101-month weighted moving average of the percentage deviations of the index numbers of deseasonalized sales, from their 13-month moving average. An ideal

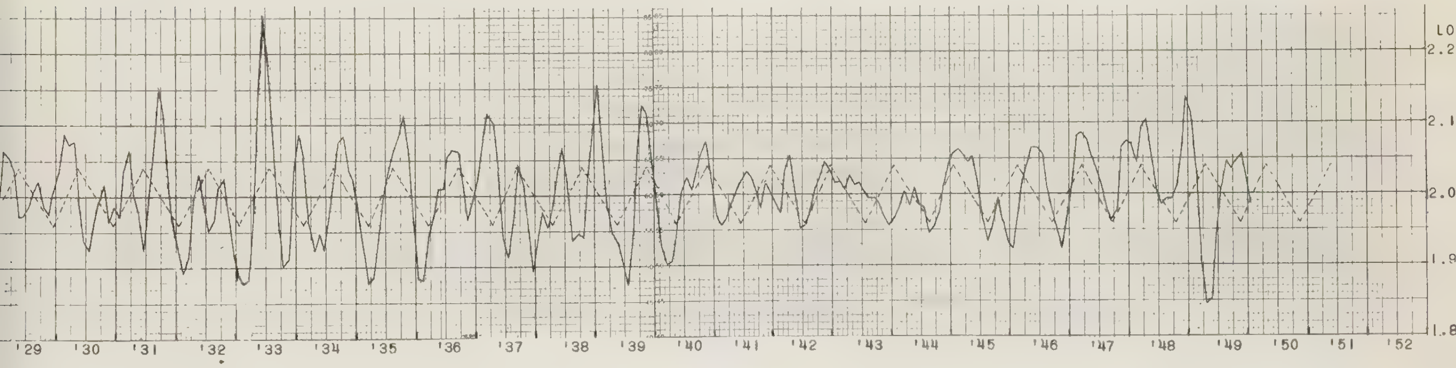
the term "compound cycle". I use this term to indicate a cycle that waxes and wanes, disappears, and then reappears upside down. Such behavior is caused by two cyclic forces, one slightly longer and one slightly shorter than the observed result.

We wanted to see if the so-called 12.58-month wave behaved in this way so as to have further light on whether or not to expect it to continue.

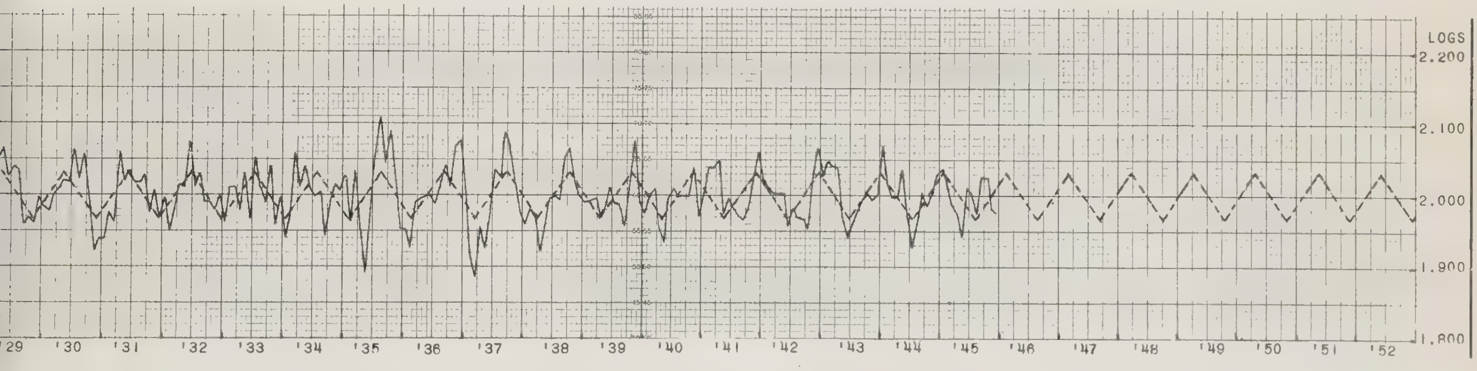
If this cycle in these figures is a simple cycle, the amplitude as revealed by a weighted moving average should be relatively constant; but if it is a compound cycle we would expect the amplitude to increase and then to decrease (or vice versa). It is easy to see from Fig. 2 that the amplitude does, in fact, remain relatively constant and therefore it appears that in this series of figures we are dealing with a simple rather than a compound wave. This fact tends to re-enforce the belief that the wave should be taken into account as a probability in any effort to forecast the sales of this company.

The elimination of other waves and accidental variations achieved by the weighted moving average also enables us to determine the length, timing, amplitude, and shape of this wave with somewhat greater accuracy.

As nearly as we can determine it, with the work done to date, the length is about .02-month longer than determined previously (12.595 instead of 12.576). The positive amplitude turns out to be 7.9% instead of 9.7 % as originally determined. The ideal timing of the most recent



average. An ideal 12.576-month cycle has been added by means of a broken line.



12.595-month cycle has been added by means of a broken line.

trough turns out to be 1/5 of a month later than originally determined.

All of these differences are inconsequential. The value of the more recent work does not lie in the refinements of measurement but in the fact that the wave seems to stand up under more powerful methods of analysis and that no evidence of compound wave behavior appears.

I am hopeful that you will attempt to find this cycle in the figures in which you are interested and that if you are successful you will let me know in order that we may build up a body of knowledge in respect to a cycle of this particular length.

If your own work happens to be with a longer series of figures it will be interesting to see whether or not the cycle continues prior to 1903. If it does, we can have even greater assurance in regard to its reality.

Financial

The receipts and disbursements of the Membership Division of the Foundation for the Study of Cycles for 1951 are shown in the following statement:

RECEIPTS			
Dues and Contributions from Members			
Dues	$10,916.81		
Contributions	2,440.00	$13,356.81	
Sale of Publications			
Reprints, etc.	825.47		
Books	290.20		
Journal of Cycle Research	776.45	1,892.12	
Dinners, N. Y. Chapter		165.00	
TOTAL RECEIPTS, Membership Division, 1951,			$15,413.93
EXPENSE			
Salaries and Rent			
Director	0		
Clerical and Rent	7,398.95	7,398.95	
Printing		3,320.48	
Direct Mail		4,201.41	
Office Expenses		2,243.35	
Books for Resale		178.87	
Operating Expenses for Journal		432.87	
Dinners for New York Chapter		136.53	
Travel Expenses		839.21	
Refunds		18.05	
TOTAL EXPENSE, Membership Division, 1951			18,770.72
LOSS, Membership Division, 1951			3,356.79

Although your Foundation lost money in the membership division it made money on its research work. In addition, it received from one of the larger foundations a grant for publicity.

We figure that the membership division will be on a self-supporting basis, except for a salary to the Director, when we have a total of 1,500 members.

At the rate at which membership is increasing we hope to reach this goal sometime during 1952.

Technical

CYCLE ANALYSIS FOR THE BEGINNER

The study of cycles is a branch of statistics. However to study cycles you do not need to know any mathematics except arithmetic.

If you have taken a course in statistics you probably have all the background you need. If not, you may wish to get a textbook of statistics and read what it says about time series analysis. It will make the subject easier for you to understand.

I do not know any textbook which will tell you much about cycle analysis. The textbook will be of use merely for general background.

My own favorite textbook of statistics is **Applied General Statistics** by Frederick E. Croxton and Dudley J. Cowden, published in 1941 by Prentice-Hall and Company of New York. This book has more in it about cycle analysis than most elementary textbooks, but for home study it is a little hard going in spots. If you do not know anything at all about statistics, you may wish to start with an easier book such as **Business Statistics** by M. A. Brumbaugh and L. S. Kellogg published by Richard D. Irwin, Inc., Chicago, 1947. (If I told you the price the Post Office Department would call this page advertising and would not only charge us advertising rates for it but would make us look up and report to them the postal zone in which each member lives. Heil!)

Business Statistics has 913 pages but you will not need to read all of it. It will be enough, I think, if you go over the following sections:

Chapter 1 Statistics in Business

Read the first paragraph entitled "The Statistical Approach".

Chapter 2 The Use of Numbers

You doubtless already know everything in this chapter but review it carefully (except the section on square roots) to make sure.

Chapter 3 Statistical Investigation

Skim this chapter lightly but read carefully the first two paragraphs under "The Cannons of Statistical Investigation" on page 46 and the paragraph entitled "Skepticism" on page 48.

Chapter 14 Graphs—Continued

The section "Time Series Graphs" (pages 328-338) is very important and should be really mastered. Also, note with care the figure on page 345 showing the right method of plotting.

Chapter 16 Measures of Central Tendency—Averages of Calculation

Chapter 17 Measures of Central Tendency—Averages of Position

You will not be able to understand Chapters 21-24 dealing with moving averages, and references that you will read in accounts of cycle analysis to moving medians and geometric moving averages, unless you master at least a part of Chapter 16 and 17. Master Chapter 16 through the first paragraph on page 389, and gain at least an understanding of what a weighted average is (page 389 to the middle of page 398). You should also master the geometric average (page 405 to the end of the chapter). In Chapter 17 you should master what it says about the median and the mode (pages 413-421).

Chapter 21 The Analysis of Time Series

Chapter 22 Trend

Chapter 23 Seasonal and Cyclical Movements

Chapter 24 Summary of the Analysis of Time Series—An Example

Here we come to the meat of this book as far as cycle analysis is concerned. As a preliminary to doing any work in this field, or even fully understanding the work of others you must know most of the contents of these four chapters (pages 537-648).

Study Chapter 21 entire.

Master Chapter 22 through page 570

You should be acquainted with the contents of the rest of this chapter because you should know that there are several mathematical ways of determining trend, but you do not need to master trend fitting in order to detect and isolate cycles, or to understand the work of others who have detected and isolated cycles. Therefore, make what you can of the rest of the chapter (pages 571-591), but if it comes hard for you, you can by-pass it.

In time series analysis it is usually preferable to find the cycles first and fit a trend to the values which remain after you have adjusted for the cycles.

As for Chapter 23 you should master this entire chapter.

Chapter 24 should be mastered, with one exception: at the middle of page 639 Brumbaugh and Kellogg introduce a description of the moving straight line trend. A moving straight line trend is an invention of Brumbaugh, and a very useful one, but for the home student it unnecessarily complicates the picture. Note what he says in the footnote "a moving average, straight line, or any other type of mathematical curve could be substituted at this point". If I were you I would simplify the exposition by substituting a moving average or a straight line trend as suggested.

Appendix C. Logarithms of Numbers

Finally, as most of your work in cycle analysis will be with logarithms you should master this chapter (pages 845-856).

You need not memorize the table of five place logarithms on pages 859-874 (GE's electrical wizard Steinmetz did)!

Similarly, you will find useful the reciprocals of numbers given on pages 875-894. (Multiplying by the reciprocal of a number gives the same result as dividing by the number; it is often much easier to multiply than divide.)

Chapter 19 Index Numbers

Chapter 20 Some Commonly Used Indexes

As the search for cycles will often use index numbers as a starting point you should understand these two chapters so that you will better comprehend the nature of the figures with which you are working, but a knowledge of index numbers as such is not necessary in order to detect and isolate cycles.

After you have got a good working knowledge of the procedures outlined in a book of elementary statistics like the one mentioned above you can go on from there and get the methods of cycle analysis from other sources. But if you do not get a good grounding in fundamentals it will be harder for you to understand the more specialized aspects of cycle analysis such as you will get in the technical section of our monthly reports and in other more or less technical writing about cycles.

Applied General Statistics

If you already own, or prefer to buy, Croxton and Cowden's **Applied General Statistics**, you should master the following:

Chapter IV, Graphic Presentation, Simple Curves.

Chapter V, Graphic Presentation, The Semi-logarithmic or Ratio Chart.

Chapter VII, Ratios and Percentages, except pages 152 to the middle of page 159. You probably know everything in this chapter, but you had better review it to make sure.

Chapter IX, Measures of Central Tendency. You can go lightly over pages 212-214 and can omit the section on the harmonic mean, pages 226-232.

Chapter XIV The Problem of Time Series. Now you are getting into the meat of it.

Chapter XV, Analysis of Time Series, Secular Trend. You will find the moving average trend the most generally useful for cycle analysis, chiefly because its effect upon cycles of every possible length is so easy to compute. However, you will occasionally have to use straight line trends, or trends of other types as described in this chapter and the one to follow.

Chapter XVI Other Trend Types.

Chapter XVII, Periodic Movements. This chapter and the one to follow will give you a good idea of cycle analysis as applied to the 12-month or seasonal cycle.

Chapter XVIII, Types of Seasonal Movements.

Chapter XIX, Cyclical Movements. This chapter is pretty rudimentary but should give you a start toward the analysis of time series for cycles of a length other than 12 months. It is as good as anything I know about in any elementary text book of statistics.

TECHNIQUES INVOLVED IN THE DETERMINATION OF

THE 12.6-MONTH CYCLE IN THE SALES OF COMPANY G

On pages 94 - 96 of this report I told you about the 12.6-month cycle in the sales of Company G. If you are interested in techniques you may wish to know more about the isolation of this cycle so as to be able to make similar studies of your own figures.

First Step

First, chiefly in order to cut down work, we expressed the monthly sales as logarithms. However, in your own work you can forget all about logarithms and do your work with the actual figures instead, if you prefer.

Second Step

The next step in the analysis of the original figures was to express the sales as percentages of their 13-month geometric moving average trend. The arithmetic moving average of the logs automatically gives you a geometric moving average, but if you are not using logs you could use the ordinary arithmetic moving average almost as well.

For an explanation of moving averages refer to any good textbook of statistics. For the use of the moving average in connection with cycle analysis, refer to the Foundation's Technical Bulletin No. 4 called **Cycle Analysis--The Moving Average** reprinted as a supplement to our October 1951 report.

Expressing the original figures as percentages of their 13-month moving average eliminates trend and minimizes cycles longer than 13 months in length. The longer the cycle the more it is minimized. Speaking roughly, Cycles as long as 26 months (2 x 13) are about 1/2 eliminated; cycles as long as 39 months (3 x 13) are about 2/3 eliminated, etc.

Third Step

Our next step was to find the 12-month or seasonal cycle in these figures.

If you do not know how to determine seasonal variation you may also refer to any good textbook on statistics. Specific references to one such textbook are contained in an article called "Cycle Analysis for the Beginer" printed in this report on pages 97 and 98.

Fourth Step

Having determined the seasonal pattern, the percentages of the actual sales of their 13-month moving average were adjusted for the seasonal pattern and thereby simplified. These simplified percentages are charted in Fig. 1 on pages 94 -95.

The preliminary work reported upon in our April 1951 report indicated a cycle in these figures about 12.58 months in length. An ideal wave of this length is shown by the broken zigzag line in Fig. 1.

The figures plotted in Fig. 1 consist not only of the 12.58-month cycle but also of shorter cycles, vestiges of longer cycles, and accidental variations. All of these together can confuse the picture so that you cannot make the best possible estimate of the exact length, amplitude, and timing of this 12.58-month cycle; nor can you be sure that it is not a "compound cycle."

A compound cycle is one that acts as if it were caused by two cyclic forces, one slightly longer and one slightly shorter than the indicated length. Such a cycle waxes and wanes in amplitude. It can be expected to disappear in time, and then to reappear upside down.

Fifth Step

To see the 12.58-month cycle more clearly in order to determine (a) its length, (b) its amplitude, and (c) its timing more accurately, and (d) to see whether or not it is a compound cycle, we then manipulated the figures by computing a 101-month weighted moving average. This weighted moving average was designed in such a way as to minimize the distorting factors as much as possible and yet to leave any regularly recurring 12.58-month waves as nearly as possible undisturbed. The results of this manipulation are shown in Fig. 2 on pages 94 - 95. See also Table 1.

The Weighted Moving Average

A weighted moving average is just the same as an ordinary moving average except that you multiply each term of the moving average by some factor or weight. All of this was explained on page 18 of our January 1952 report.

There are an infinite number of weights that you could choose for your weighted moving average. The problem at this point, therefore, is one of choosing the particular weighted moving average that will best accomplish the results you have in mind, namely, to leave the 12½-month cycle as undisturbed as possible and to eliminate accidental variations and other cycles as completely as possible.

You can compute the effect that any given weighted moving average would have on any other cycles which might be present. From the preliminary analysis reported upon in our April 1951 story you know the other cycles that seem to be present in this series of figures. You can therefore discover the effect of each weighted moving average formula you choose to test upon each of these cycles.

Amplitude Charts

In connection with this particular 12.58-month cycle, we devised six different weighted moving averages and investigated their effect upon all the tentatively determined cycles. The results are shown in Figs. 1-6 herewith on pages 102 and 103.

The horizontal scale on these charts represents wave length in months. The vertical scale represents the amplitude remaining after the computation of the weighted moving average on the assumption that the cycles are regular, symmetrical, and zigzag in shape.

Thus, in Fig. 1, for the wave length of 12.5 months you will observe a point plotted against 100. This means that the manipulation has no effect whatever upon the amplitude of symmetrical zigzag waves 12.5 months long.

The point opposite the wave length of 27.5 is 45% which means that 45% of the amplitude of such waves will remain after the calculation of this particular weighted moving average.

Waves 15 months long are present for -10% of their original amplitude. This means that the wave has been overcorrected by the weighted moving average so that we now have troughs where there used to be crests and vice versa, but the reversed wave is present for only 1/10 strength.

Figs. 1-6 show the effect upon the regular symmetrical zigzag waves in the original data. Actually, such waves would acquire a different shape when expressed as percentages of their 13-month moving average, but Figs. 1-6 do not take this fact into account.

The objective, of course, is to reduce all of the waves except the 12.5-month wave as nearly as possible to 0 amplitude.

The fifth formula seems to achieve this result more nearly than any of the other formula and was therefore the formula adopted.

Application of the Weighted Moving Average

In the actual application of the weighted moving average to the original deseasonalized percentages (Fig. 1 on pages 94 - 95), in order still further to minimize random variations we used the median of the weights for positions 7, 20, 82, and 95 and the median for the weights of positions 1, 26, 76, and 101.

I imagine that at this point you are wondering how we happened to hit upon the various formulae that we devised.

I am afraid that that is too long a story for this particular report, expecially as I plan to write a series of articles on the use of the weighted moving average in cycle analysis which will appear in the **Journal of Cycle Research.** These articles should answer the questions of the limited number of our members who want to go into this matter more deeply. If you are impatient you will find some material on this subject in the June 1950 report on pages 12-15 inclusive.

Sixth Step

Having computed the weighted moving average values, these values are plotted as shown in Fig. 2 on pages 94 and 95.

From the fact that the amplitudes of the various 12.6-month waves are relatively uniform, we conclude that the wave is not compound and therefore that there is no internal evidence that it will fade out and reverse.

Seventh Step

There remains only to determine as exactly as possible the length of the wave, and its amplitude, shape, and timing.

The length of the wave is determined as follows: First, the weighted moving average values are entered into a 12.576-month periodic table.

A periodic table is merely an arrangement of the data in rows of some particular length. If there is a cycle of the length of the rows the crests of the cycle will all fall in one column and the troughs will all fall in another column. If the columns are averaged, the cycles of other lengths and the accidental variations that are present will tend to "wash out," and the wave obtained by averaging the various columns will show you the shape, amplitude (height), and timing of the cycle.

On the work sheet (Table 2) all values under 2.000 are recorded in red and values above 2.000 are recorded in black. I do not know whether or not this use of color will show up when the work sheet is reproduced in print but it may, because the red pencil makes a somewhat broader line and may come out somewhat blacker. If so, you will see a clear tendency for the lows to dominate positions 1 and 2 and positions 9, 10, 11, 12, and 13.

The length of 12.576 months is chosen for the length of the periodic table because it is the length of the cycle as determined in the preliminary examination of the figures. This length must therefore be quite close to the true length.

If the cycle is a little longer than the length of the table the highs and lows will creep to the right on successive lines. Conversely, if this cycle is a little shorter than the length of the table the waves will creep to the left as you go down the page.

The closest approximation to the length of the cycle can usually be obtained by finding the position of the cycle in the first and second halves of the table separately and noting the extent of the slippage, one way or the other, between the two halves.

As the data provide us with thirty six 12.576-month cycles the periodic table has 36 lines; 18 lines in each half.

As the average of the first half of the periodic table epitomizes the behavior for the first 18 cycles and the average of the second half of the periodic table epitomizes the behavior for the second 18 cycles the two averages idealize behavior 18 cycles apart. If the crests and troughs of the average of the second half of the table come one month after the crests and troughs of the average of the first half of the table the cycle obviously advances one month in 18 cycles and is therefore 1/18 of one month longer than the length of the periodic table.

If crests and troughs drop back a month it indicates that the true length of the cycle is 1/18 of one month less than the length of the table.

In the process of averaging, the four highest values and the four lowest values in each column of each half of the periodic table are omitted in order to eliminate the largest distortions. These values are marked with a dot.

Also, the averages obtained from each half of the periodic table are smoothed by a 5-month moving average so as to enable us to determine the time of crest and trough in each half of the series as accurately as possible.

Actually in this series of figures the crests and troughs advanced by about 1/3 of a month, we therefore conclude that the length is 1/3÷18 or 1/54-mo., (.019-mo.), longer. Adding .019 to 12.576 gives us 12.595, the true length, as nearly as it can be determined in a series of this length and irregularity.

This step also gives us the typical or ideal timing of the wave because we know the timing of the periodic table, the first half of which is based on month number 197.5.

As the average of the periodic table referred to above shows that the crests come 5 positions after base we see that crests fall in month 202.5 (197.5 + 5.) or at the end of October 1917, and every 12.595 months before and thereafter.

Lows of the ideal cycle fall 6.3 months after the highs and can be calculated easily.

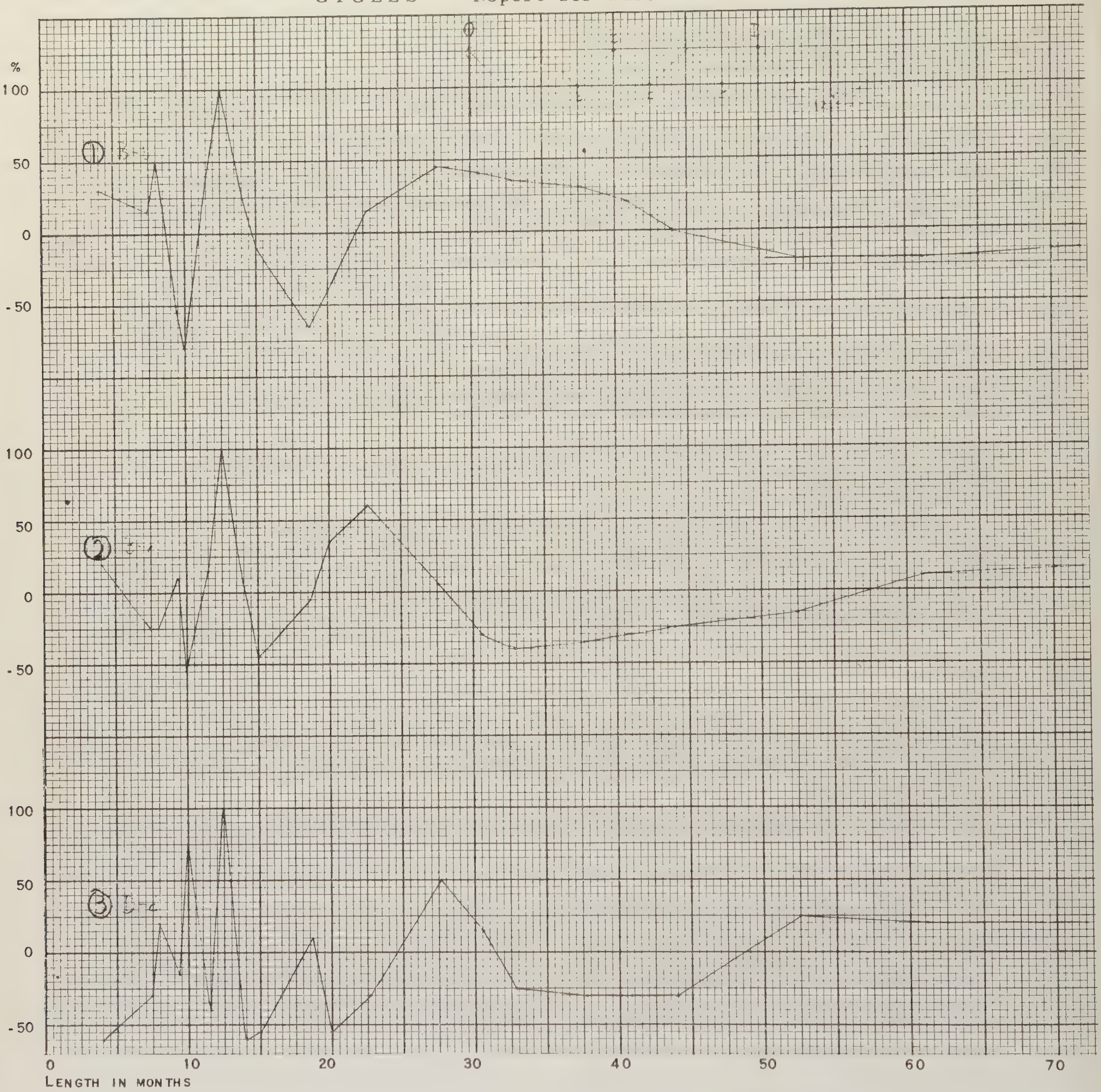
Eighth Step

The final step consists of determining the amplitude of the wave and, as nearly as may be, its shape.

To do this we add both halves of the periodic table together, slipping the second half 1/3 positions to the left, compute the 5-month moving average in order to produce a moving average of the amplitude and shape disclosed, from which we can reconstitute the original wave.

The shape seems to be zigzag and the amplitude in logs turns out to be ±.033.

To summarize the seventh and eighth steps:



Work charts showing effect of various weighted moving average formulae upon the amplitude of all waves discovered in the preliminary analysis of the sales of Company G.

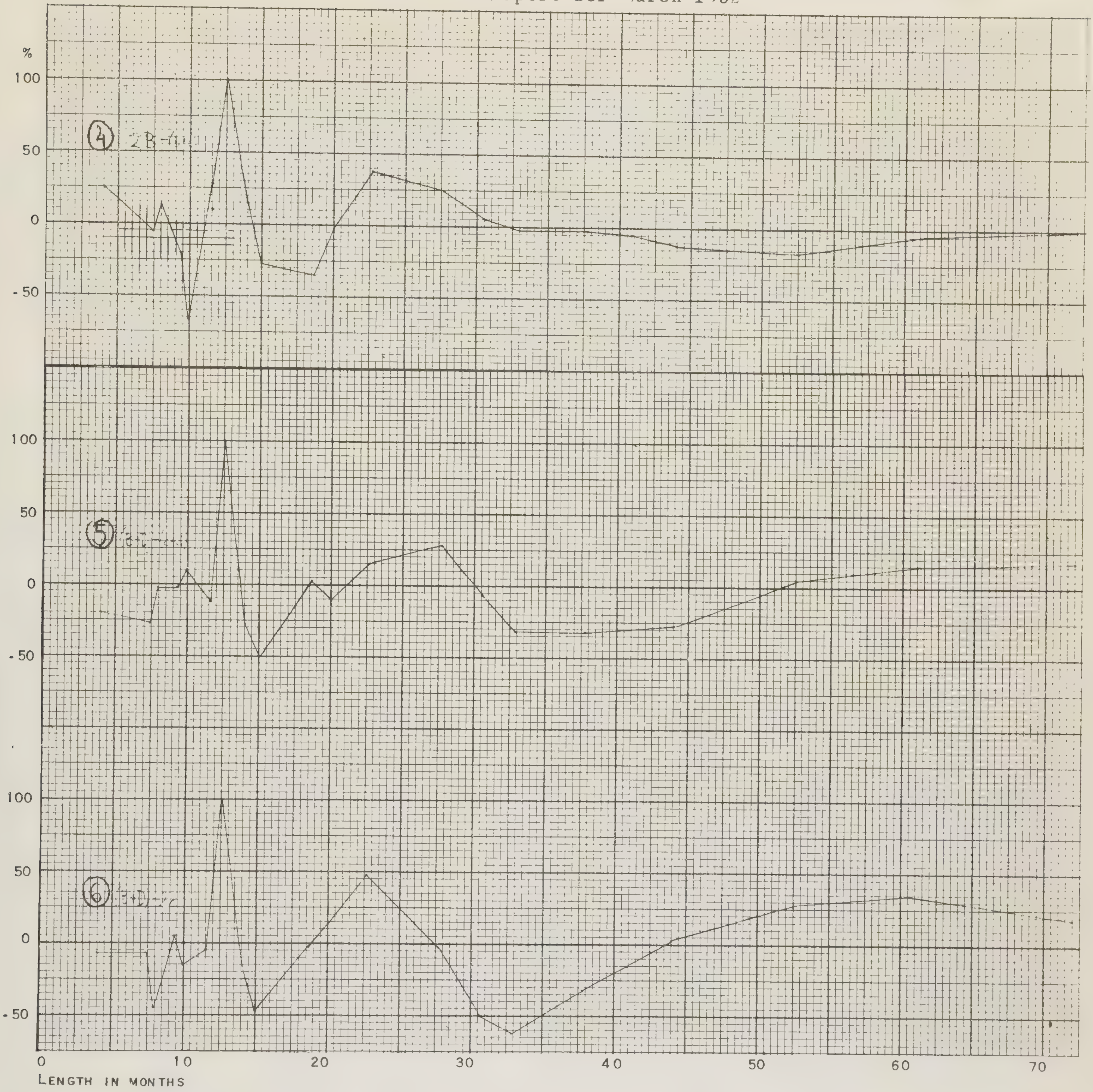
The length of the cycle is shown by the horizontal scale. Percentage amplitude remaining after aplication of weighted moving average formula is shown by the scale at the left.

Fig. 1 shows the effect of a 51-month weighted moving average with weights as follows: 1st term 1/4, 7th term -1/4, 45th term -1/4, 51st term 1/4, and all other terms 0.

Fig. 2 shows the effect of a 63-month weighted moving average with weights as follows: 1st term -1/4, 7th term 1/4, 57th term 1/4, 63rd term -1/4, and all other terms 0.

Fig. 3 shows the effect of a 101-month weighted moving average with weights as follows: 1st term 1/4, 7th term -1/4, 95th term -1/4, 101st term 1/4, and all other terms 0.

Fig. 4 shows the effect of a 63-month weighted moving average with weights as follows: 1st



TERM -1/8, 7TH TERM 1/4, 13TH TERM -1/8, 51ST TERM -1/8, 57TH TERM 1/4, 63RD TERM -1/8, AND ALL OTHER TERMS 0. (IN PRACTICE DISCARD HIGHEST AND LOWEST OF 1ST, 13TH, 51ST, AND 63RD TERMS AND APPLY WEIGHTS OF -1/4 TO THE TWO REMAINING VALUES.)

FIG. 5 SHOWS THE EFFECT OF A 101-MONTH WEIGHTED MOVING AVERAGE WITH WEIGHTS AS FOLLOWS: 1ST TERM 1/8, 7TH TERM -1/8, 20TH TERM -1/8, 26TH TERM 1/8, 76TH TERM 1/8, 82ND TERM -1/8, 95TH TERM -1/8, 101ST TERM 1/8, AND ALL OTHER TERMS 0. (IN PRACTICE DISCARD HIGHEST AND LOWEST OF 1ST, 26TH, 76TH, AND 101ST TERMS AND 7TH, 20TH, 82ND, AND 95TH TERMS AND APPLY WEIGHTS OF 1/4 AND -1/4TH TO THE REMAINING TERMS RESPECTIVELY.)

FIG. 6 SHOWS THE EFFECT OF A 101-MONTH WEIGHTED MOVING AVERAGE WITH WEIGHTS AS FOLLOWS: 1ST TERM, 1/8, 20TH TERM -1/4, 26TH TERM 1/8, 76TH TERM 1/8, 82ND TERM -1/4, 101ST TERM 1/8, AND ALL THE REMAINING TERMS 0. (IN PRACTICE DISCARD HIGHEST AND LOWEST OF 1ST, 26TH, 76TH, AND 101ST TERMS AND USE WEIGHTS OF 1/4 FOR REMAINING TERMS).

TABLE 1.

CALCULATION OF THE FIRST TWO TERMS OF THE 101-ITEM WEIGHTED MOVING AVERAGE OF THE SALES OF COMPANY G

		A	B	C	D	E	F
DATE	MONTH NUMBER	INDEX OF DATA	LOGS OF INDEX	13-MONTH MOVING AVERAGE OF COL. B	DEVIATIONS OF LOGS FROM THEIR 13-MO. MOVING AVERAGE COL. B + 2.0000 - COL. C.	SEASONAL PATTERN, IN LOGS	DESEASONALIZED DEVIATIONS COL. D + 2.000 - COL. E
MAY 1903	29	4,660	,6684				
JUNE	30	3.423	,5344				
JULY	31	6.356	,8032				
AUG	32	5.086	,7064				
SEPT	33	11.000	1.0414				
OCT	34	6.138	.7880				
NOV	35	9.866	.9941	.9717	2.0224	2.0177	2,0047
DEC	36	6.596	.8193	1.0099	1.8094	1.8337	1.9757
JAN 1904	37	23.764	1.3759	1.0481	2.3278	2.0406	2.2872
FEB	38	10.465	1.0197	1.0764	1.9433	2.0284	1.9149
MAR	39	17.761	1.2495	1.1239	2.1256	1.9550	2.1706
APR	40	21.888	1.3401	1.1429	2.1972	1.9730	2.2242
MAY	41	19.598	1.2922	1.1674	2.1248	1.9635	2.1613
JUNE	42	14.607	1.1644	1.1831	1.9813	1.9964	1.9849
JULY	43	10.755	1.0315	1.2119	1.8196	2.0042	1.8154
MAY 1905	53	15.900	1.2014	1.2205	1.9809	1.9635	2.0174
JUNE	54	19.660	1.2936	1.2354	2.0582	1.9964	2.0618
JULY	55	19.350	1.2867	1.2419	2.0448	2.0042	2.0406
AUG	56	16.210	1.2098	1.2330	1.9768	2.0300	1.9468
SEPT	57	15.360	1.1864	1.2155	1.9709	2.0705	1.9004
OCT	58	15.000	1.1761	1.2273	1.9488	2.0870	1.8618
NOV	59	16.670	1.2219	1.1935	2.0284	2.0177	2.0107
DEC	60	25.200	1.3014	1.2037	2.0977	1.8337	2.2640
JAN 1906	61	19.130	1.2817	1.1890	2.0927	2.0406	2.0521
FEB	62	11.980	1.0785	1.1925	1.8860	2.0284	1.8576
DEC 1907	84	10.200	1.0080	1.2804	1.7276	1.8337	1.8939
JAN 1908	85	16.650	1.2214	1.2757	1.9457	2.0406	1.9051
FEB	86	22.740	1.3568	1.2732	2.0836	2.0284	2.0552
MAR	87	23.800	1.3766	1.2624	2.1142	1.9550	2.1592
JAN 1910	109	16.220	1.2101	1.2765	1.9336	2.0409	1.8930
FEB	110	18.050	1.2565	1.2778	1.9787	2.0307	1.9503
MAR	111	12.240	1.0878	1.2724	1.8154	1.9604	1.8604
APR	112	12.080	1.0821	1.2639	1.8192	1.9797	1.8462
MAY	113	19.880	1.2984	1.2608	2.0375	1.9635	2.0740
JUNE	114	14.560	1.1632	1.2558	1.9074	1.9964	1.9110
JULY	115	35.440	1.5495	1.2746	2.2749	2.0042	2.2707
AUG	116	22.180	1.3460	1.2961	2.0499	2.0300	2.0199
SEPT	117	19.120	1.2815	1.3151	1.9664	2.0705	1.8959
OCT	118	20.650	1.3149	1.3409	1.9740	2.0870	1.8870
AUG 1911	128	27.170	1.4341	1.4734	1.9607	2.0300	1.9307
SEPT	129	30.610	1.4859	1.4712	2.0147	2.0705	1.9442
OCT	130	30.360	1.4823	1.4846	1.9977	2.0870	1.9107
NOV	131	33.910	1.5303	1.4990	2.0313	2.0177	2.0136
DEC	132	22.970	1.3612	1.5068	1.8544	1.8337	2.0207
JAN 1912	133	44.370	1.6471	1.5171	2.1300	2.0406	2.0894
FEB	134	29.900	1.4757	1.5280	1.9477	2.0284	1.9193
MAR	135	28.850	1.4601	1.5413	1.9188	1.9550	1.9638
APR	136	47.660	1.6782	1.5503	2.1279	1.9730	2.1549
MAY	137	40.790	1.6105	1.5637	2.0478	1.9635	2.0843

G	H	I	J	K	L	M	N
Position numbers for 1st term of weighted moving average	Weight	Deseasonalized deviations times weight to be used as basis for 1st term of moving average	First term of weighted moving average	Position numbers for 2nd term of weighted moving average	Weights	Deseasonalized deviations times weights to be used as basis for 2nd term of moving average	Second term of weighted moving average
1	1/4	.5012					
2	0	0		1	1/4	.4939	
3	0	0		2	0	0	
4	0	0		3	0	0	
5	0	0		4	0	0	
6	0	0		5	0	0	
7	-1/4	-,5403		6	0	0	
8	0	0		7	-1/4	.4962	
9	0	0		8	0	0	
19	0	0		18	0	0	
20	-1/4	.5155		19	0	0	
21	0	0		20	-1/4	.5102	
22	0	0		21	0	0	
23	0	0					
24	0	0					
25	0	0		24	0	0	
26	1/4	.5666		25	0	0	
27	0	0		26	1/4	.5130	
28	0	0		27	0	0	
50				49	0	0	
51			1,9717	50	0	0	
52				51	0	0	2.0330
53				52	0	0	
75	0	0		74	0	0	
76	1/4	.4876		75	0	0	
77	0	0		76	1/4	.4651	
78	0	0		77	0	0	
79	0	0		78	0	0	
80	0	0		79	0	0	
81	0	0		80	0	0	
82	-1/4	.5050		81	0	0	
83	0	0		82	-1/4	.4740	
84	0	0		83	0	0	
94	0	0		93	0	0	
95	-1/4	.4861		94	0	0	
96	0	0		95	-1/4	.4777	
97	0	0		96	0	0	
98	0	0		97	0	0	
99	0	0		98	0	0	
100	0	0		99	0	0	
101	1/4	.4910		100	0	0	
				101	1/4	.5387	

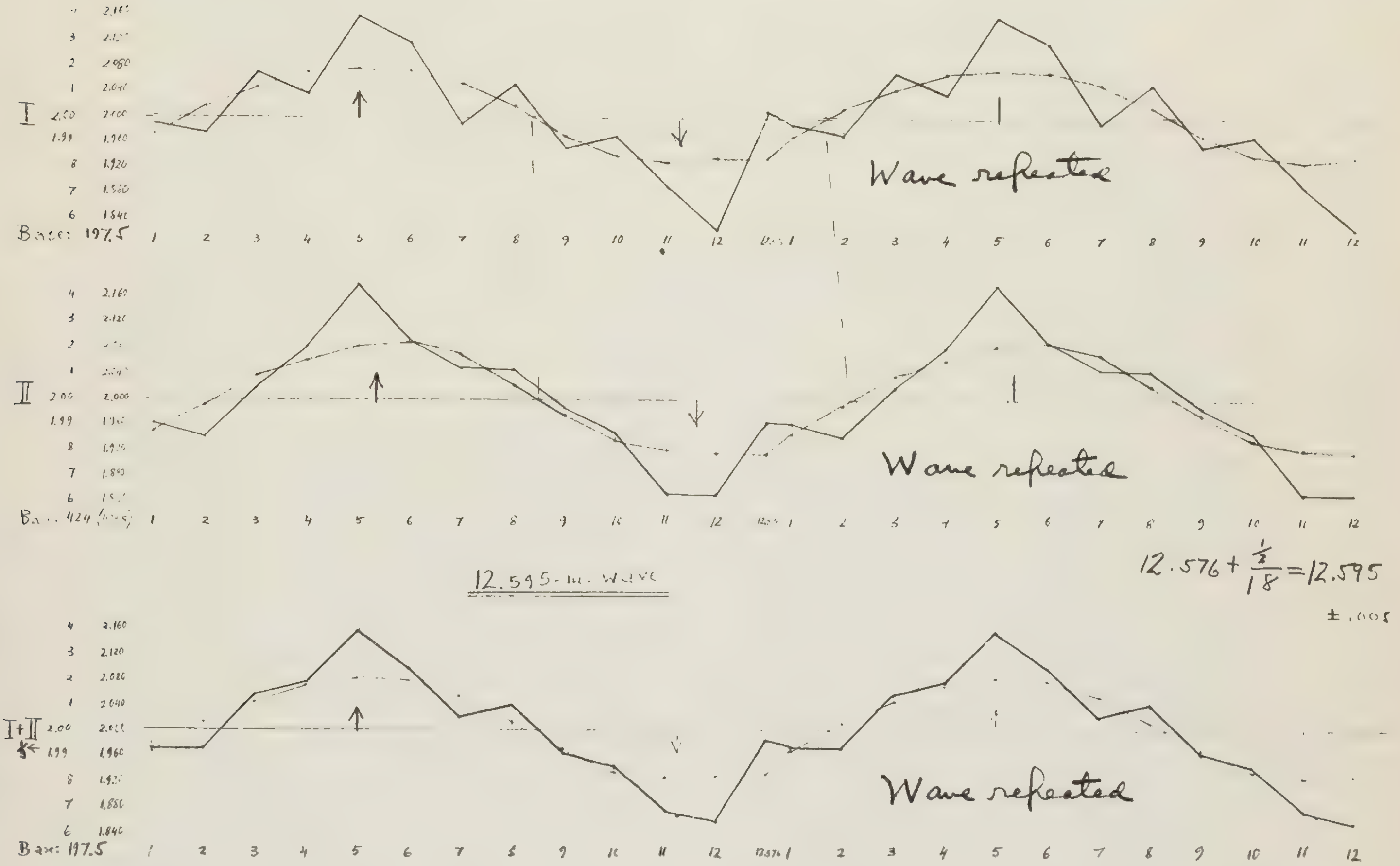
TABLE 2.

COMPANY G.A 12.576-MONTH PERIODIC TABLE OF THE 101-TERM WEIGHTED MOVING AVERAGE OF THE DEVIATIONS OF THE DESEASONLIZED INDEXES OF SALES FROM THEIR 13-MONTH GEOMETRIC MOVING AVERAGE.

BASE MONTH	MONTHS AFTER BASE MONTH													
	1	2	3	4	5	6	7	8	9	10	11	12	12.576	
84.00	1.887 •	2.132 •	2.108	1.980	2.139	2.210 •	2.099 •	1.525 •	1.987	2.166 •	1.929	2.133 •	2.015	
97	2.268 •	1.845 •	1.800 •	2.117	1.927 •	2.150	2.059	2.060	2.038	1.890	1.839	1.878	× 1.822 •	
109	1.822 •	2.098 •	2.180	2.162	2.329 •	1.943 •	2.211 •	1.914 •	1.815 •	1.840 •	1.717 •	1.845	1.895 •	
122	2.126 •	1.945	2.239 •	2.182 •	2.214	2.069	2.166 •	2.203 •	1.815 •	1.690 •	1.859	1.754	× 1.768 •	
134	1.768 •	1.913	2.182 •	2.363 •	2.215	2.346 •	1.987	1.848 •	1.942	1.857 •	1.922	1.851	2.041	
147	2.056	2.059 •	2.019	1.995	2.005 •	2.106	1.973	2.098	2.044 •	2.080 •	2.287 •	1.842	× 2.074 •	
159	2.074	2.054	2.120	2.000	1.779 •	2.189	1.799 •	1.650 •	1.882	1.933	2.201 •	2.095 •	2.089 •	
172.0	2.286 •	1.950	2.134	1.873 •	1.923 •	2.297 •	1.821 •	2.113	1.831 •	2.065	2.072 •	1.718 •	2.138 •	
185	2.018	2.080 •	2.107	1.958 •	2.128	2.081	1.936 •	2.136 •	1.796 •	1.955	1.690 •	1.725 •	× 2.252 •	I
197 –	2.252 •	1.828 •	2.149 •	2.032	2.124	2.109	2.003	2.154 •	2.080 •	1.981	1.988	1.864	1.984	
210	2.075	1.816 •	1.986	2.198 •	2.144	1.980 •	1.944 •	2.129 •	2.069 •	1.960	1.811	1.905 •	× 1.922 •	
222	1.922	1.986	1.985 •	1.844 •	2.163	2.155	1.973	2.067	1.978	2.263 •	1.967	1.903	1.937	
235	1.928	1.979	1.761 •	1.970 •	2.042	2.036	2.028	1.988 •	1.916	2.223 •	1.687 •	1.733 •	× 1.998	
247	1.998	1.939	2.221 •	1.977	2.281 •	2.260 •	1.946	2.107	1.888	2.049	1.935	1.770	2.006	
260.0	1.942	1.988	1.992	1.977	2.201	2.185	1.955	2.017	1.863	1.968	1.732 •	1.769	2.046	
273	1.895	2.004	2.017	2.091	2.226 •	1.913 •	2.141 •	2.048	1.992	1.998	1.801	2.025 •	× 1.992	
285	1.992	1.882 •	1.927 •	2.076	2.183	2.080	2.025	2.078	2.044 •	1.938	1.894	1.741 •	2.044	
298	1.889 •	1.973	2.056	2.176 •	2.310 •	1.897 •	1.972	1.929	2.043	1.704 •	1.998 •	1.771	× 2.025	
310	2.025	2.015 •	1.930 •	2.297 •	1.927 •	2.222 •	2.000	2.030	2.083	1.776 •	1.790	1.787	1.981	
323	1.924	2.121 •	2.165 •	2.232 •	2.085	2.102	1.995	2.014	1.980	1.803 •	1.995	1.775 •	1.941	
336	1.931	1.800 •	2.310 •	2.214 •	2.255	2.105	2.150	2.141	1.836 •	1.871	1.848	1.989 •	× 1.934	
348.0	1.934	1.909	2.003	2.033	2.081 •	2.076	2.254 •	2.091	2.225 •	2.002	1.689 •	1.754 •	1.756 •	
361	1.903	1.853 •	2.242 •	2.078	2.131	2.070	2.066	2.105	1.897	2.026 •	1.874	1.981 •	× 1.798 •	
373	1.798 •	1.918	2.055	2.047	2.295 •	2.045 •	2.115	1.962	1.961	1.912	1.996 •	1.846	2.047 •	
386	2.041 •	1.916	2.122	1.866 •	2.205	2.043 •	1.956 •	2.164 •	1.830 •	1.986	1.768	1.879	× 2.233 •	
398	2.233 •	2.046 •	2.149 •	2.034	1.989 •	2.016 •	1.773 •	1.958	2.062	2.025	2.106 •	1.853	2.132 •	
411	1.802 •	1.568 •	1.908 •	2.215 •	2.432 •	2.176	2.346 •	2.120	1.806 •	1.805 •	1.698 •	1.959 •	1.982	II
424 –	1.991	1.992	1.952	2.056	2.164	2.050	2.268 •	2.301 •	2.054	1.681 •	1.542 •	1.816	× 1.702 •	
436	1.702 •	1.913	2.136	2.109	2.351 •	2.252 •	2.080	1.914 •	1.840	1.919	1.877	1.689 •	1.836 •	
449	1.977	1.995	1.973	2.212	2.263	2.071	1.990	1.958 •	1.969	1.982	1.889	1.917	× 2.047	
461	2.047 •	1.949	1.947	1.831 •	2.044 •	2.301 •	1.957 •	1.896 •	1.998	2.033 •	1.813	1.737 •	1.975	
474	2.038 •	1.992	2.000	1.997	2.158	1.886 •	2.008	2.153 •	2.151 •	2.194 •	1.895	1.981 •	× 1.923	
486	1.923	1.885	1.863 •	1.924 •	2.102	2.240 •	2.092	2.046	2.015	2.011	2.015 •	1.826	1.925	
499.00	1.872 •	1.857 •	1.813 •	2.120	2.263	2.112	2.189 •	2.163 •	2.156 •	1.882	1.765	1.836	1.913	
512	1.979	2.005 •	1.971	1.996 •	2.277 •	2.066	1987	1.994	2.137 •	1.884	1.711 •	1.847	× 2.013	
524	2.013	1.945	2.011	2.115	2.144	2.067	1.950 •	1.898 •	1.772 •	2.047 •	2.010 •	1.897	2.106 •	
537	2.162	1.928	1.898											
I Aver. −4H −4L 5-m. mov. aver.	1.990 1.974	1.973 2.016	2.072 2.045	2.035 2.070	2.155 2.074	2.116 2.070	1.992 2.053	2.051 2.017	1.953 1.973	1.974 1.939	1.894 1.931	1.825 1.938	2.009 1.938	
II Aver. −4H −4L 5-m. mov. aver.	1.960 1.94[illegible]	1.941 1.992	2.017 2.035	2.080 2.061	2.177 2.082	2.090 2.088	2.048 2.019	2.046 2.023	1.986 1.976	1.947 1.936	1.851 1.919	1.850 1.914	1.965 1.913	
I+II ½ 5-m. mov. aver.	1.971 1.967	1.970 2.011	2.055 2.044	2.074 2.069	2.152 2.079	2.096 2.076	2.020 2.054	2.039 2.012	1.963 1.968	1.944 1.935	1.872 1.924	1.856 1.926	1.985 1.931	

FIG. 7

CHART OF THE AVERAGES OF THE FIRST AND SECOND HALVES OF THE PERIODIC TABLE SHOWN ON THE OPPOSITE PAGE AND CHART OF THE AVERAGE 12.595-MONTH WAVE.



crest at pos. 5
low at pos. $11\frac{1}{4}$ } to base 197.5

Amplitude ± .080 (actual .020)

$\frac{5}{12.595}$ = 39.7 %

.133 (actual [illegible]

current crest at 605.5
618.1
630.7

The results of this work indicate that the 12.58-month cycle is not compound, that its length, as nearly as can be determined at the present time, is 12.595 months ± .005 month, that its amplitude is 92.8% of trend at trough and 107.9% of trend at crest, that its shape is symmetrical, and that crests fall Oct - Nov. 1917 and every 12.595 months thereafter.

THE ARITHMETIC

It may be helpful if I work out the actual arithmetic for you. It is as shown in Table 1.

Month Number

For the standard system of month numbers, refer to **Cycles** for September 1950.

Column A - Index of Data

The figures in this column from May 1903 to date were supplied by the company.

Column B - Logs of data

Chiefly for ease of manipulation you convert the values in Column A to logs.

Column C - 13-month moving average

The first item in this column, .9717, is the average of the first 13 items in Column B. That is to say, the sum of the 13 values in Column B from .6684 to 1.2922 inclusive divided by 13. You post this item to the middle or 7th position of the 13 sales values being averaged.

The second value in Column C, 1.0099, is the average of the 13 values in Column B from .5344 to 1.1644 inclusive, and so on down the page from 1903 to date.

Column D - Deviations from 13-month moving average.

The first item in this column is obtained by subtracting .9717 (Column C) from .9941 (Column B) and adding 2.0000 (to avoid negative numbers and to convert to percentages).

The second point is obtained likewise, .8193-1.0099 is -.1906, add 2.000 and you get 1.8094.

The rest of the figures in Column D are computed similarly.

Column E - Seasonal pattern

The values in this column are merely the typical seasonal pattern repeated over and over again every 12 months. That is, 2.0177 appears opposite every November (except during wartime when a different seasonal pattern prevails), 1.8337 opposite every December, except during waretime and so on.

Column F - Deseasonalized deviations

You obtain the first item in this column by subtracting 2.0177 (Column E) from 2.0224 (Column D) and adding 2.0000 to the result (to avoid negative numbers and keep the result in percentages).

The Weighted Moving Average

The particular weighted moving average chosen has a length of 101 months.

All of the weights are 0 except as follows:

1st item	1/4
7th item	-1/4
20th item	-1/4
26th item	1/4
76th item	1/4
82nd item	-1/4
95th item	-1/4
101st item	1/4

To apply these weights you multiply the corresponding value in Column F by the weight.

The 101-item numbers are shown for your convenience in Column G. The weights are shown in Column H. Column I gives the product of each deseasonalised deviations (Column F) times its weight. Thus, the weighted value for the first position (which falls at month number 35) is 2.0047 x 1/4 or .5012. The weighted value for month number 36 is 1.9757 x 0 or 0. The weighted value for month number 41 is 2.1613 x -1/4 or -.5403.

The eight significant multiplications give you values as follows:

1st item	.5012	
7th item	-.5403	(This is the highest negative value)
20th item	-.5155	
26th item	.5660	(This is the highest positive value)
76th item	.4876	(This is the lowest positive value)
82nd item	-.5050	
95th item	-.4861	(This is the lowest negative value)
101st item	.4910	

These are the only values you need to bother with for the first term of your moving average, as all the other values are 0. You then obtain the median of the positive and the median of the negative values by discarding the highest and lowest positive value and the highest and lowest negative value. The values to be discarded are indicated in the table above.

This leaves you four values as follows:

.5012
-.5155
-.5050
.4910

You then add these values to get -.0283 and add 2.0000 to avoid negative numbers and keep the result in percentages. This computation gives you 1.9717 which is the first term of your weighted moving average.

This value is posted at the mid point of the 101 items of the moving average, namely, position fifty one at month number 85. Moving averages always have to be posted and plotted at the mid-point of the values averaged.

This first term of the 101-month weighted moving average, namely, 1.9717 is posted in Column J of the table and is plotted as the first point of the weighted moving average chart, in Fig. 2 on pages 94 and 95.

For the second term of the weighted moving average the 101 position numbers in Column G are all dropped down one month as shown in Column K. The computation proceeds in the same way to give us the second term of the weighted moving average, 2.0330, plotted against the 51st item of this group of 101 items. This central position for the second group of 101 items comes of course one month later than the central position of the first 101 items. That is to say, it comes in month number 86 instead of month number 85. This value is the second point plotted on Fig. 2 on pages 94 and 95 .

You then proceed this way month by month to get weighted moving average values for all months from January 1908 through December 1945.

As with any moving average you lose values at each end of the series. For example, you cannot know the weighted moving average for month number 84 unless you have the sales for month number 28.

The procedure is not quite as laborious as it sounds as there are some shortcuts for the actual computations but it is still quite a lot of work. For a series of this length and a moving average formula of this complexity the computations take at least two days clerical time.

Periodic Table

Base numbers are placed at the left in the stub and the columns are headed "months after base."

Base numbers used are standard month numbers as given in our report for September 1950. January of 1901 is month number 1.

As the first figure available is for January 1908, which is month number 85 the first base number is 84.

As this is a 12.576 month table you get the other base numbers by putting 84 in your machine and adding 12.576 cummulatively and rounding. The base numbers will increase by 12 and 13 alternately except occasionally where the excess over 12.500 "catches up."

The lines are either 12 or 13 items long according to the number of months between base numbers. To fill up the right hand or 13th column (headed 12.576) the blank spaces thus created are filled up by use of the next number of the series, which is a duplication of the first number on the next line.

The first figure in the periodic table, 1.9717, is the first weighted moving average value recorded in Column J of Table 1 on page 104. This is the value for the 85th month, one month after the base of 84.

The second figure in the periodic table, two months after base, is 2.0330. This figure comes from Column N of Table 1 at month number 86. And so on.

(To save work, we used weights of ± 1 instead of 1/4, dividing by 4 at the end. The values in the work sheet reproduced as Table 2 will therefore show 4 times the correct deviations.)

The averaging of each column of each half of the table, minus the four highest and the four lowest figures in each, should pose no problem. Neither should the smoothing of these values by a 5-month moving average.

The average waves for each half of the periodic table and their smoothed values are plotted in Fig. 7. The slippage of 1/3 position to the right is readily apparent, especially if one measures from the points where the curve, as it goes up and down, cuts the axis.

If I have not made the procedures entirely plain to you please write to tell me why, so that I can try to do better another time.

JOURNAL OF CYCLE RESEARCH

The second issue of the new quarterly Journal of Cycle Research, recently released, contains the following material:

Guest Editorial

The issue starts with a **guest editorial** by Dr. Harlan T. Stetson.

Dr. Stetson was for many years a professor of astronomy at Harvard. Since 1940 he has been Director of the Laboratory of Cosmic-Terrestrial Research at the Massachusetts Institute of Technology.

Research

Two rather lengthy research articles and one technical article follow the guest editorial of Dr. Stetson.

One of the research articles is by Professor A. G. Huntsman and is entitled **Causation of the 9- or 10-Year Salmon Cycle**. This article is illustrated with five tables and seven charts. A number of references are appended.

Dr. Huntsman has been professor of biology at the University of Toronto since 1927 and has been Editor and Consulting Director of the Fisheries Research Board of Canada since 1934. In 1938 he was president of the Royal Society of Canada. His scholarly paper will appeal to all who are interested in the cause of cyclic behavior.

The other research article is entitled **War Cycles and the 6-Year Cycle in Cotton Prices, 1731-1949** and is by me.

It shows the behavior of cotton prices after each of our previous major wars and discusses the 6-year cycle as it has appeared in cotton prices since 1731.

The article suggests that this 6-year cycle is a compound cycle. It gives the length of four components which seem to combine to create it. It shows the result of imaginary trading in cotton prices on one of these components for the period covered. Excluding short positions during war, total gains before brokerage would have been 1407%.

Since 1902, assuming no short position during war, the gains would have been 653%. As the article says, "Obviously we are talking here about a behavior pattern of great importance, and one about which more should be known by all who grow, buy, sell, use, or trade in cotton."

The article enables the reader to project this cycle into the future and to determine dates of ideal highs and lows of this cycle if it continues.

The article contains four charts and two tables.

This article is a reprinting of Foundation Report No. 2 with additional material to bring it up to date. It shows that the 6-year cycle has continued to operate in these figures.

Technical

The technical article is also by me and is called **A New Form of Periodogram**. This paper suggests a new form of periodogram believed by the author to have merit from the standpoint of cycle analysis.

The issue concludes with some never-before-printed data furnished by the Hudson's Bay Company, and with a section called Notes and News.

Letters

"Keep Yourself a Free Agent"

My dear Mr. Dewey:

Question No. 6 in your Questionnaire, which I have filled out and enclose, could not be answered with a simple "Yes" or "No" - hence this letter.

Perhaps you have few members of the Foundation who are as completely amateurs as I am - very likely most of the members are well educated technically - hence my point of view may not be of particular value.

I am one of those who felt that your work, from the earliest moment I discovered it, was of great importance and who felt it tremendously interesting, but my interest is of a broad social nature rather than that of a technician. When you adopted the monthly publication I felt you had made a good move, and yours is one of the few publications that I save. If I did not cull out and throw away a great mass of the material I receive, my office would turn into a library.

Now then, the number of pages that you use in your monthly issue should be governed not by whether we like 44 or 36 pages but by what you have to say **without padding**, and the same holds true for the number of times you publish.

The danger of most magazines lies in the fact that some purely arbitrary pattern is set, and then along comes some month when not enough genuine material is available - and the padding begins. This is not a criticism of "Cycles" as it has appeared so far. It is a general statement applying to most magazines. Your independent position free from the support of advertisers should make it possible for you to issue the size of magazine consistent with the material you have available without the necessity of expanding it. Therefore I say, use the number of pages that will suit what you have to offer, and issue it monthly or every other month, as the situation demands.

You are one of the few editors who is a free agent and I hope you will keep yourself free. Meanwhile the material is splendid and my only sorrow is that there have not been enough centuries of record-keeping to give us surer patterns!

Very truly yours,
Ralph Barstow

Covina, California.

My Reply

Dear Mr. Barstow:

Your letter was very encouraging.

I have enough material to fill almost any number of pages per month if I had the time to put it together.

The reason I would like to cut down the number of our pages a trifle is not lack of material, but lack of time to do significant research when I have to prepare too many pages for publication.

I am not quite the free agent that you imagine. It is true I am not under pressure from advertisers, but I am under pressure from readers who want information of immediate practical usefullness, and sometimes are unwilling to permit the excursions into the byways which, in the long run, are likely to be of greater significance.

I appreciate what you say about the importance of our work. The study of cycles provides a tool which may ultimately prove to be of enormous value. Wherever you have fluctuations that are not the result of random forces you have something which requires explanation and which reveals to us our ignorance about the phenomena in question. Wherever you have two phenomena fluctuating in the same cycle you have the possibility of interrelationship. All we at the Foundation for the Study of Cycles can do, however, is to point out cycles and identity of cycle length, leaving it for others who know more than we do to offer the explanation.

Very cordially yours,

Correspondence with Alfred Cowles, President, Cowles Commission for Research in Economics, University of Chicago

7 December 1951

Dear Mr. Cowles:

I was very happy to get your letter of November 26.

Is your interest in our work sufficient so that you would be interested to help our project along? . . .

I feel very strongly that in the subject of cycles we have a tool of great potential usefullness (A) in uncovering **possible** interrelationships that might not otherwise be discovered, (B) in uncovering the existence of unknown forces if there be such which have a bearing on the resultant behavior, and (C) eventually forecasting.

I am concerned solely in the use of cyclic knowledge as a tool. I have no theories whatever as to interrelationships that might or "ought to" exist or of the nature of the forces that cause non-random rhythmic fluctuations. These forces are likely to be different for different time series and may in some instances be internal or dynamic, in other instances external or environmental.

I am fully aware that rhythm may come about by random forces and that such meaningless rhythms do not differ importantly from many of the rhythms that have been discovered by cycle students in various series of figures.

I hold no brief for any particular cycle or cycles, but it seems to me unreasonable to believe that all of the cycles that have been discovered are random manifestations, particularly as many of them have kept on manifesting themselves after discovery. This is something that cycles in random numbers could not reasonably be expected to do often.

I hope I have made a case for the potential usefullness of cycle research. . .

Returning now to my original query: (1) Is there any possibility of your organization developing tests that are adequate to give the significance of any given cyclic manifestation? (2) Would you be willing to give me your frank opinion as to the reports we have issued to date with particular emphasis upon any failures of omission or commission from the standpoint of your circle of friends and associates? (3) Would you be willing occasionally to review or have reviewed by your staff in advance of publication such material as our Technical Bulletin No. 3, having to do with the Hoskins time chart or our Technical Bulletin No. 4, having to do with the moving average in cycle analysis?

Cordially yours,
Edward R. Dewey

10 December 1951

Dear Mr. Dewey:

I have your letter of December 7 and have referred your inquiry to Professor Tjalling C. Koopmans, Research Director of the Cowles Commission for Research in Economics, University of Chicago. I have supplied him with the copies of the September, October, and November, 1951 monthly reports entitled **Cycles** and also with the **Journal of Cycle Research**, Autumn 1951. We are doing business cycle research and I shall be glad to let you know what the comments are of the people in our organization who are actively engaged in that field.

Sincerely,
Alfred Cowles

27 December 1951

Dear Mr. Dewey:

In my letter to you of December 10 I undertook to get a report on the work of the Foundation for the Study of Cycles from Professor Tjalling C. Koopmans, research director of the Cowles Commission for Research in Economics. Enclosed herewith are the comments of Mr. Koopmans, a bibliography of literature dealing with statistical techniques in cycle analysis, and also a list of some studies in the analysis of business cycles.

Sincerely,
Alfred Cowles

Some Comments on the Publications of the Foundation for the Study of Cycles

Most of the studies published are concerned with the analysis of a single time series over a long period of time. In the econometric analysis of business cycles, the trend of the last twenty years has been toward studying cyclical phenomena through a measurement of the simultaneous interrelationships of several variables. In this way the attention has shifted from measurement of individual periods, amplitudes and phases toward the mechanism responsible for cyclical movement, and measurement of the important parameters of this mechanism.

I believe that this shift in attention has been justified in studying economic cycles, and could imagine that the same approach might be fruitful in some of the other fields with which the Foundation is concerned. If experience in the econometric field is relevant here, the answer to this question would have to be given by theorists in these other fields (meteorology, biology, oceanography, etc.). The experience in econometrics has been, that the time series of interrelated variables by themselves do not constitute sufficient information to unravel the relationships present, but need to be supplemented by theoretical reasoning from the economic motive and other facts of general experience.

Whether cycles are studied in isolation or through study of interrelated variables, safeguards against spurious findings must be found in mathematical statistical theory telling us what appearances can be produced by pure chance. Again this analysis is more helpful if it can be based on some indubitable assumptions regarding the underlying mechanism.

Attached are two lists of literature, one dealing with statistical studies on testing for serial correlation and other cyclical phenomena, the other giving some econometric studies devoted to the analysis of business cycles through the interrelationships of variables.

T.C.K.

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2. J. Tinbergen, "An Econometric Approach to Business Cycle Problems," Paris, 1937, Actualites Scientifiques et Industrielles 525.

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Dear Mr. Dewey:

If you have a "Household Hints Department" in "Cycles-A Monthly Report" you may be interested in a simple method that I have found quite useful in locating the peaks and length of cycles.

After I have plotted a curve I lay the graph paper flat on my desk. Then I take a handful of pencils and lay them on the most promising peaks. I keep moving them until they look to be equidistant from each other.

Fig. 1 shows such a curve with pencils laid at 72-month intervals.

Fig. 2 shows a perfectly regular cycle (H) superimposed on the curve (G), that was developed from the mean values of the various 72-month cycles contained in this curve.

Regards,
Charles H. Pinkham
Lydia E. Pinkham Medicine Company,
Lynn, Massachusetts.

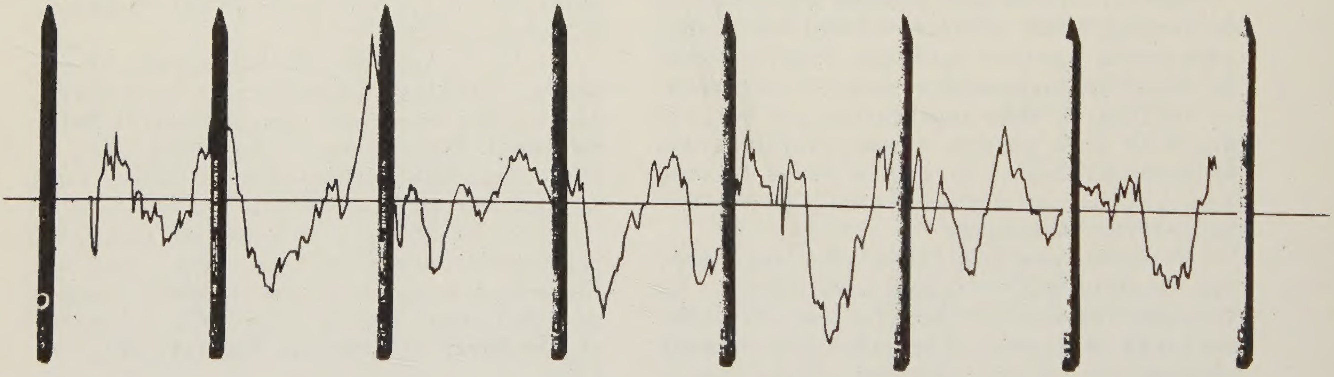

Fig. 1

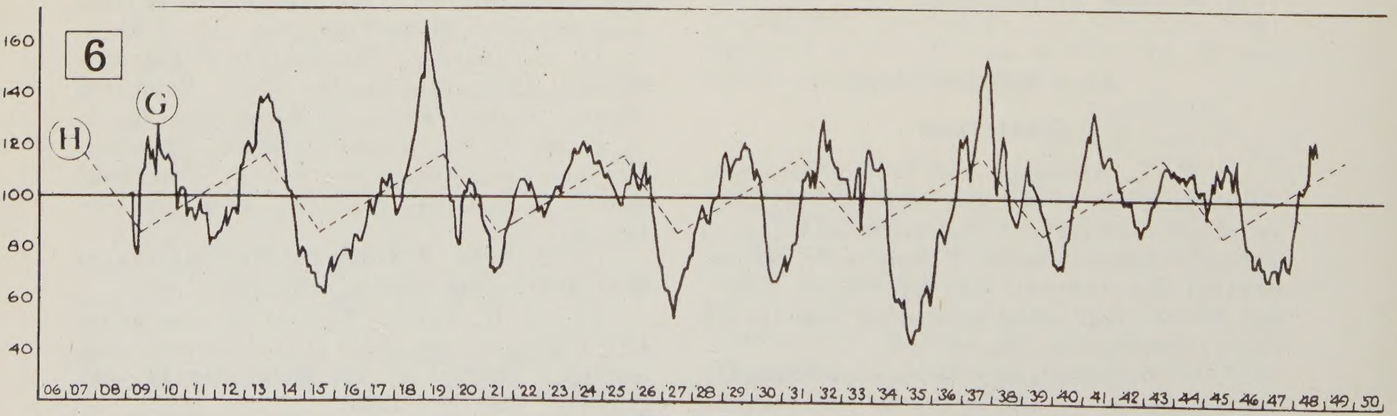

Fig. 2

Additions to the Library

"The British Wheat Price Curve and The Weather Trends Since 1260 A. D.," by Raymond H. Wheeler, **Journal of Human Ecology**, Vol. 1, No. 9, 1951, 36 pages, 14 charts. Gift of the Weather Science Foundation.

There is much more for the cyclic student in this paper than the title implies for Dr. Wheeler sees numerous cycles apparently present in both weather trends and British wheat prices over the past 700 years.

Dr. Wheeler is a trail blazer and students of cycles will want to follow up with exhaustive detail the provocative correspondences and relationships suggests by Dr. Wheeler in this paper.

● ● ●

"Über eine neue biologisch wirksame Komponente der Sonnenstrahlung. Beitrag zu einer experimentellen Grundlage der Heliobiologie," by Maki Takata. Reprinted from **Archiv für Meteorologie, Geophysik und Bioklimatologie**, Serie B: Allgemeine und biologische Klimatologie, Band II, 5. Heft, 1951, Springer-Verlag in Wien, 23 pages, 10 charts. Gift of the athor.

This interesting paper written in German with supplemental summaries in French and English can perhaps be best described by reprinting the English summary in full. It reads as follows:

Summary.

It is reported upon a new biological effective solar radiation, which until now was unknown and is measurable only with our "index of flocculation" in bloodserum (Flz-Reaction of Takata). This radiation stands in good correlation with the solar activity, by the following effects:

1. Effect of sunrise and sunset (systematic increase and decrease of the Flz by sunrise and sunset).
2. Eclipse effect (dimintion of the Flz during a solar eclipse).
3. Effect of altitude (exponential increase of the Flz together with altitude in the atmosphere).
4. Effect of latitude (increase of the Flz with diminishing geographic latitude).
5. Eleven years' period (Flz fluctuations parallel to the variations of the relative sunspot numbers.)
6. Effect of the solar rotation (marked tendency to repetitions of the stormy Flz disturbances after 27 days).
7. World-wide phenomenon with cosmic rhythm.

From this report it is evident that the "vitalionizing" radiation, which we had proved during 17 years day by day, fulfils all requisitions for the verification of a new effect of the solar radiation. There is no doubt about that the solar radiation must contain a new component with biological effect, which is characterized by its strong penetrating power and by its ionizing power for the human body.

● ● ●

'Secrets of the Ocean Bed—Dating the Changing Climate of the Past," by J. D. H. Wiseman, reprinted from **The Times**, September 22, 1950, three pages. Gift of Dr. Wiseman.

This reprint of an article by Dr. Wiseman explains the methods of estimating prehistoric temperatures by means of the composition of undisturbed cores from the depths of the ocean. In this paper Dr. Wiseman gives the dates of various eras of maximum and minimum temperature from about 117,000 B.C. He does not, however, call attention to any regularly recurring cycles in these fluctuations and of course there may be none.

On the other hand, data extended over so long a period of time are inevitably of interest to cycle students who wish to see whether or not cycles of more recent periods continue into the far distant past.

FISHERMEN, ATTENTION!

Would you like to see a report in regard to the 9.6-year cycle in the abundance of Atlantic salmon?

This report was prepared by Professor E. B. Phelps of Columbia and Professor D. L. Belding of Boston University for the members of the exclusive Restigouche Salmon Club.

Through the courtesy of the club this material was published by us as Foundation Reprint No. 20.

The name of the report is "A Statistical Study of the Records of Salmon Fishing on the Restigouche River." It is 6 3/4" by 9 3/4" in size, 37 pages long, and contains eight charts.

If you want a copy of this report, send $1. The reprint will be sent you by return mail.

FOUNDATION FOR THE STUDY OF CYCLES

9 EAST 77th STREET NEW YORK 21, N. Y.